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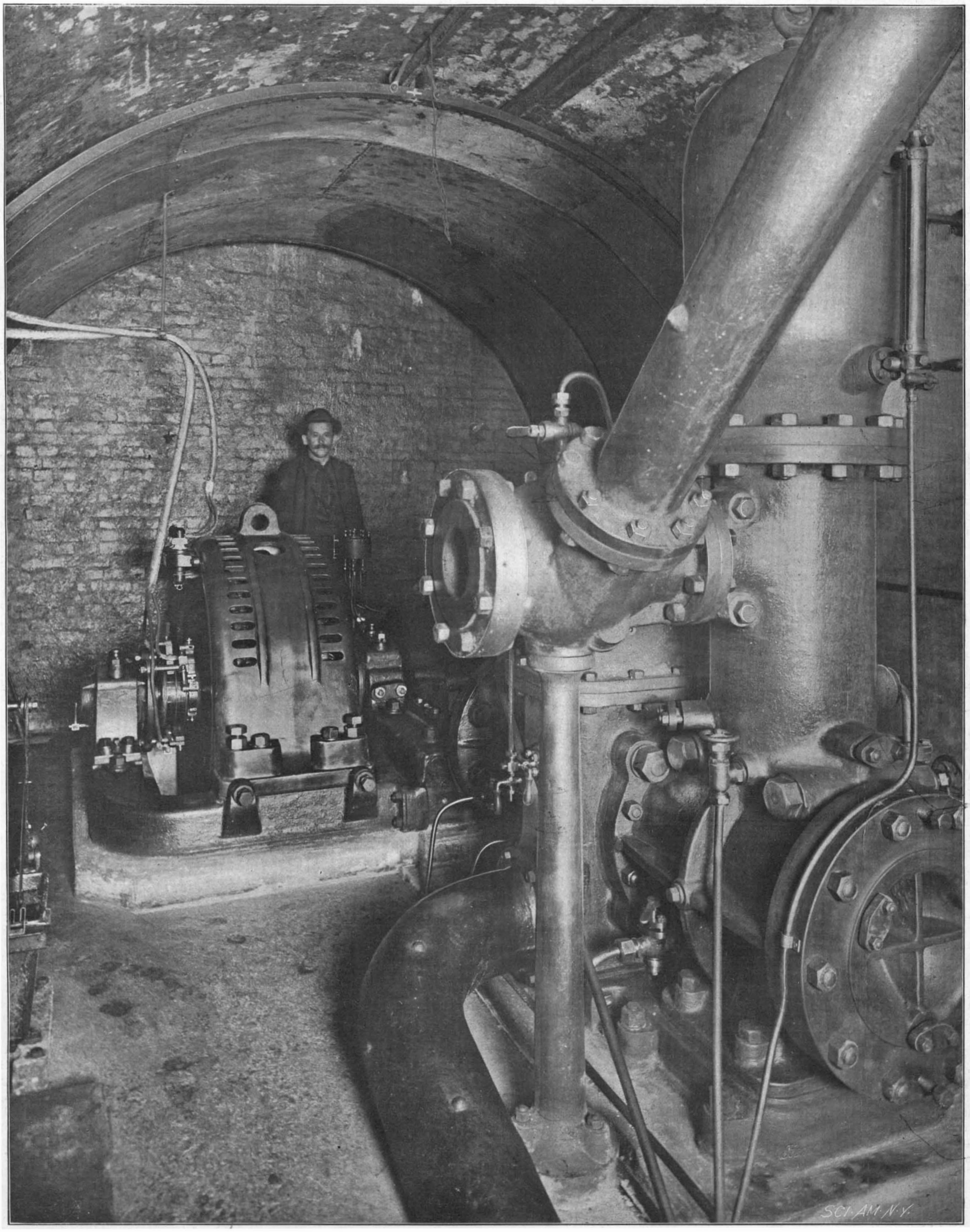

ELECTRICITY IN MODERN MINING INSTALLATIONS.—AN ALTERNATING-CURRENT MOTOR DRIVING A MINING-PUMP UNDERGROUND.—[See page 223.]

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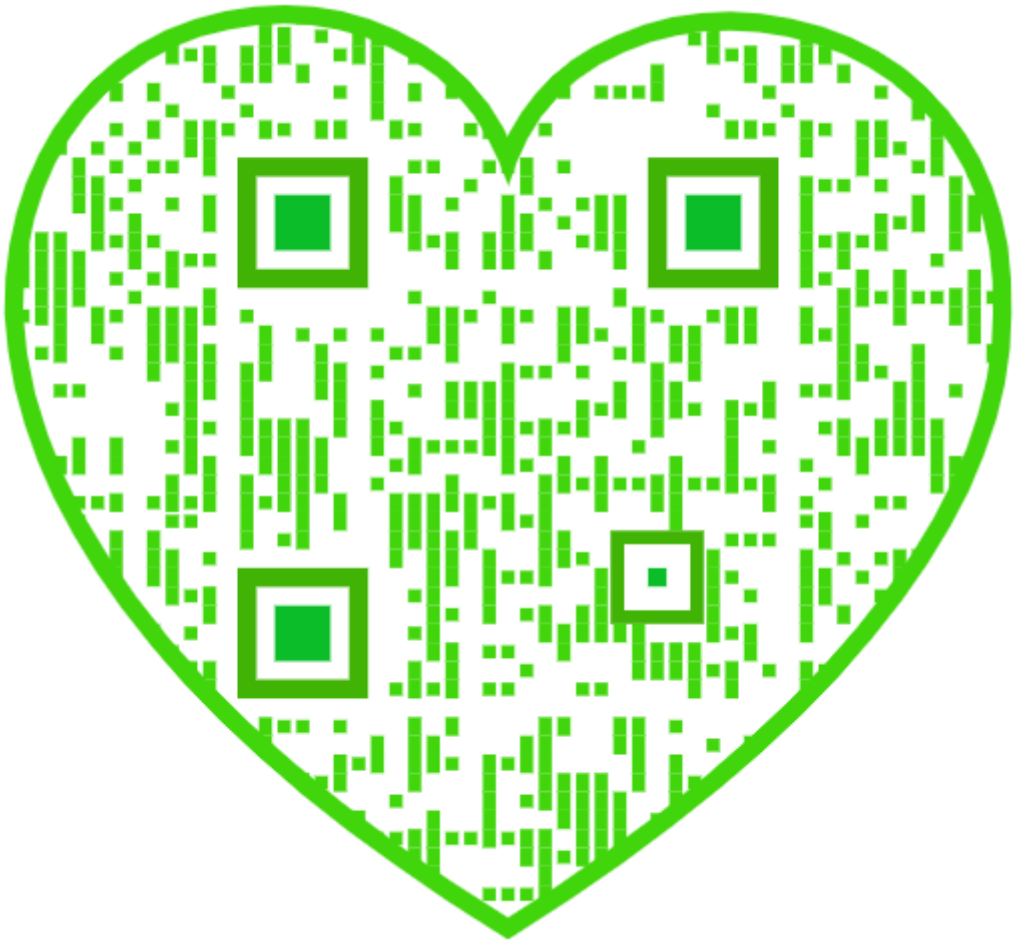

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NEW YORK, SATURDAY, MARCH 28, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RATIFICATION OF THE PANAMA CANAL TREATY.

The decision of the Senate, by an almost unanimous vote, in favor of the ratification of the Panama Canal treaty with Colombia, marks the close of one of the most momentous and long-drawn-out controversies in the history of Congress. Moreover, to those who have followed closely the political history of the Panama-Nicaragua Canal struggle, this happy consummation will be regarded as a distinct triumph of common sense and sober second thought over much misinformation, some measure of misrepresentation, and a large measure of general ignorance upon what was first and last a highly technical subject.

The SCIENTIFIC AMERICAN has double cause to be pleased at the outcome. We are gratified to realize that by this decision the country's energies have been diverted from a doubtful undertaking at Nicaragua to a perfectly practicable one at Panama. We find further cause for gratification in the fact that at a time when there was a woful lack of knowledge as to the actual merits of the two routes, the SCIENTIFIC AMERICAN was the first journal to place these facts clearly and succinctly before the public in a popular and perfectly understandable form, thereby initiating that campaign of public enlightenment which was all that was needed to insure the final adoption of the Panama route as being from every point of view the most feasible.

In the winter of 1898-99, when we undertook to investigate impartially the merits of the two routes and place the full engineering data in comparative form before the public, the prospect of the adoption by the nation of the Panama route appeared to be practically hopeless, and this for more than one reason. In the first place, there was in favor of Nicaragua that most potent of all arguments, the so-called patriotic one; for Nicaragua had been associated from the very first in the minds of the American people with American engineers and American capital. Indeed, it was looked upon as the distinctively American scheme as opposed to Panama, which represented in the popular eye a purely European and, therefore, in some sense an antagonistic enterprise. And Panama, moreover, was laboring under the odium of the failure and scandals arising out of the gross mismanagement of the first Panama Canal Company; while scarcely less potent than this was the active propaganda which had been carried on by the Nicaragua interests through the press against the Panama Canal scheme as such; especially as concerns its physical and strictly engineering aspects. The floods of the Chagres River and the sliding in of the great Culebra cut had been insisted upon in many a lengthy magazine article by well-known engineers, as rendering the construction of a successful canal at Panama an absolute physical impossibility. All the manifest advantages of that route (now so well understood and appreciated) were never so much as hinted at; while the general public was left with the impression that the failure of the first Panama Company was due entirely to the physical obstacles to a canal at this point, and not, as is actually the case, to the gross mismanagement and willful misappropriation of funds which marked the first attempt at construction. On the other hand, the flood of literature, laudatory of Nicaragua, which had been poured out upon the country, expatiated at length upon the supposed advantages of the rival scheme, such as the existence of the Nicaragua Lake, the shortness of the cut to the main divide, etc., and passed over, almost without reference, the glaring weaknesses in the Nicaragua plans, such as the construction of the huge rock-fill dam across the San Juan River, and the building of miles of costly and unstable retaining embankments along the proposed high-level route.

To the late Gen. Ludlow is due primarily the credit for stemming this tide of misinformation by his most able and impartial report, made after his commission returned from an investigation of the Nicaragua route, a report which was sustained first by the Walker commission, and finally by the President's commission.

It is true that the first report of the President's commission was in favor of the construction of the Nicaragua route, but the commission carefully stated that this choice was due to the exorbitant price asked by the Panama Company for their properties on the route of the canal. As soon as this company agreed to accept for these properties the price of $40,000,000, which was their value as assessed in the report, the commission unanimously reported in favor of the Panama route. Briefly summed up, the advantages that determined this choice as stated by the commission were: That the Panama route would be 134.6 miles shorter; that it had fewer locks and less curvature; that it would take a vessel 21 hours less time to traverse the canal; and that the annual cost of maintenance and operation would be $1,300,000 less. With the ratification of the treaty, the last hindrance to the completion of this magnificent work is removed. Of the enormous value, commercial and political and military, of the canal to this country, it is unnecessary to speak; and we have not a doubt that the future historian of the rise and growth of the great republic of the western world will bear out the statement that few decisions of more significant and wide-reaching effect have been taken than this vote of Congress to cut a deep-sea canal route through the Isthmus.

A SIGN OF THE TIMES.

There are many proofs of the flourishing condition of the shipbuilding trade in this country, and none of them is stronger than the fact that it is exceedingly difficult to secure a sufficient number of really skilled workmen to insure the carrying out of orders within contract time. Only recently we noted in these columns that in a report of the Chief Constructor to the Secretary of the Navy, delay in the construction of vessels was attributed to the scarcity not only of skilled workmen, but also of persons equipped with competent technical knowledge in the designing, drafting, and oversight necessary in the construction of ships. This scarcity, by the way, is noticeable not merely in naval work, but in general marine work, even including that specialized branch of it known as yacht designing.

Now in these days, when so many professions are over-supplied, we think it is timely to direct attention to the present scarcity in naval architecture and suggest that, in view of the great expansion which will take place in the future of our shipbuilding interest, both merchant and naval, it would be well for any young man who is thinking of going into draftsmanship, whether merely as a handicraft or as a stepping-stone to the full mastery of some particular profession, to remember there is no more promising field, just now, than that of naval architecture. That ship draftsmen are particularly scarce is shown by the fact that the Chief Constructor of the Navy has only recently sent out a memorandum to the effect that there is an immediate demand for all-round ship draftsmen, not merely at headquarters, but at several navy yards throughout the country. The rapid growth of our commerce renders it likely that the present activity in naval construction will continue, and the field thus opened is a promising one.

RISE OF WATER POWER IN ELECTRICAL SUPPLY.

BY ALTON D. ADAMS

Water power is destined to operate the greater part of electrical supply and street railways in North America. A large beginning in this direction has already been made. Electrical loads are being transferred to water power faster than they are created and steam plants reduced to occasional use. Meantime development of the vast resources of water power on this continent is only in its initial stage.

It is hardly half a decade since the advantage of water power in systems of electrical supply was still a mooted question. To-day the rapid introduction of water power is the most notable change that is taking place in electrical systems. The connecting link between many water powers and their wider application in electric lighting and traction is long distance transmission at high voltage. It now seems a far cry back to the transmission of energy over a distance of thirty miles at 10,000 volts in Southern California, during 1892. At that time the distance and the voltage both seemed to many engineers impracticable. Ten years later as many as ninety transmission systems in North America employ a voltage equal to or exceeding that of the pioneer plant. The water-power plants of these systems are equipped with generators of more than 276,000 horse power capacity. Of this generator capacity the United States contains approximately 222,000, Canada 33,000, and Mexico 21,000 horse power. These figures are necessarily incomplete and below the actual facts because of the rapidity with which additions are being made.

Besides the systems in which energy from water power is transmitted at pressures not less than 10,000 volts there are great numbers that are so near to their water powers that this voltage is not necessary.

It is not possible to give comprehensive figures for either the number or capacity of these systems that transmit water power at pressures below 10,000 volts in North America, but this may be done for the electrical supply systems of a single State. These systems in Massachusetts to the number of eighteen, in the present year, have generating equipments at water power stations with a total of more than 10,000 horse power capacity, all sending out energy at less than 10,000 volts. Compared with the 10,000 horse power of 1902, the electric lighting stations of Massachusetts contained water-driven equipment of only 685 horse power in 1891. No doubt figures from other States would show a similar growth in the number and capacity of these transmissions from water power at moderate voltages.

Turning again to the transmissions at 10,000 or more volts, they may be found scattered through twenty States, besides Canada and Mexico. The greatest single water power system is that at Niagara with a capacity of 50,000 horse power in actual use and an addition of 30,000 horse power partly completed. The next largest plant is that at Colgate, Cal., of 15,000 horse power; Chamblay, Quebec, follows with a plant of nearly 11,000 horse power, and then come the water-power systems at Hamilton, Ontario, and Snoqualmie Falls, Washington, with 8,000 horse power each, in capacity of electric generators. Not less than eighteen transmission systems have water-power equipments of 4,000 or more horse power capacity, and as many as fifty-five systems drive generators of not less than 1,300 horse power with water. Among the States, New York leads with a capacity of nearly 100,000 horse power in its electrical transmissions from water power, but one-half of this is at the Niagara plant alone. California is second in point of capacity, with about one-half that of New York in its numerous, long transmissions. Utah, Montana, and Colorado follow with not less than 15,000, 12,000, and 8,000 horse power capacity respectively in their systems of transmission at above 10,000 volts from water powers.

California leads in the use of high voltage, having at least one system that operates at 60,000 volts. Montana has a transmission at 50,000 volts, and Utah and Michigan contain 40,000-volt systems. In Canada at least four water-power plants operate at 20,000 or more volts on their lines. Minnesota has one 30,000-volt transmission and Alabama another. At least two transmissions in New York are carried out at 20,000 or more volts. More than forty-five systems now employ 15,000 or more volts on their transmission lines.

California again leads in the distances over which electrical transmissions are carried out. That State contains one system with 140 miles, and another with 145 miles of line between the water-power station and the point where the greater part of the energy is used. In Montana there is an electrical transmission seventy miles long. Utah has a transmission of 55 miles, and Washington two of 45 miles each. In Michigan there is a transmission line 46 miles long from a water-power plant, and Minnesota has a similar line of 28 miles. Electrical energy is transmitted 30 miles from water power in Alabama, 27 miles in New York, 20 miles in Maine, 25 miles in Colorado, and 37 miles in Ontario.

The transmission systems of 10,000 or more volts pressure show a range from 25 to 133 in the numbers of cycles per second of the alternating currents employed. The lower of these figures is the standard at Niagara, but probably in only one of the other systems. One plant in Canada and one in California employ 133-cycle current. In a few other transmission systems may be found energy at 30, 38, 50, and 66 cycles per second. The standard for most of these water-power transmissions, however, is 60 cycles per second. This general preference for the 60-cycle current is due to the fact that it is suited to the operation of both arc and incandescent lamps as well as to that of induction motors. Most of the plants operating at less than 60 cycles per second deviate the greater part of their energy to the operation of motors.

Of the 90 transmissions at not less than 10,000 volts, only one is carried out with single-phase current. Three-phase lines are the most numerous, comprising more than fifty out of the total. About 39 of these high pressure systems operate two-phase. Induction motors, arc and incandescent lamps give equally good results on systems of either two- or three-phase, but the three-phase currents have a small advantage as to the transmission lines. Great extensions are to be expected with two- and three-phase currents between 40 and 60 cycles per second.

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THE LATEST EDISON STORAGE BATTERY PATENT

Thomas A. Edison was granted a patent on March 3 last for an improvement in his reversible galvanic battery in which an alkaline electrolyte and insoluble electrolytically-active materials are used. The invention relates particularly to the oxidizable element, and consists in the use of cobalt oxide, preferably mixed with metallic mercury or with metallic mercury and copper or silver, whereby a great proportion of the cobalt oxide is kept in electrical contact with the electrode and made electrolytically active in an alkaline solution to form the oxidizable element on discharge. The invention also consists in the combination of such an element with a suitable depolarizer furnishing oxygen on discharge in an alkaline electrolyte, so as to form a complete reversible galvanic battery.

In order to produce the new element, Mr. Edison says he prefers to proceed substantially as follows: "Dried oxalate of cobalt is first produced in any suitable way and is ignited and kept at a low temperature in the air until it has been wholly decomposed to form the anhydrous oxide of cobalt. This oxide is then mixed with preferably about 15 per cent of precipitated oxide of mercury if an electrode is to be obtained composed of cobalt and mercury, or, if desired, it may be mixed, preferably, with about 25 per cent of finely-divided metallic copper and 6 per cent of precipitated oxide of mercury if the resulting electrode is to be formed of cobalt and a combination of copper and mercury. These proportions, of course, may be varied; but those indicated give good results. By increasing the portion of mercury, or of mercury and copper, a larger proportion of the cobalt is rendered active; but the increase in efficiency is secured at a sacrifice of lightness and economy. Silver may also be employed in place of the copper; but it possesses the objection of being too expensive at the present time for economical use. The mixture of oxide of cobalt and oxide of mercury or of oxide of cobalt, metallic copper, and oxide of mercury is then mixed thoroughly, formed into briquettes, and utilized in any desired manner, preferably by being supported in perforated nickel-plated pockets or receptacles, which in turn are crimped in position within plates or grids, as I have described in patents already granted to me.

"An electrode containing a mixture of cobalt and mercury, or of cobalt, mercury, and copper or silver, is preferably employed in an alkaline solution of, say, 20 per cent of potassic hydroxide in water, opposed to a depolarizing element containing nickel hydroxide as the active material mixed with foliated or flake graphite. When such a combination has been charged and recharged several times, its average voltage is about 1.10 volts. When such a combination is in a fully-charged condition, the nickel hydroxide is raised to a very high state of oxidation, and the cobalt is reduced so far as its active particles are concerned to the metallic state. On discharging, the nickel hydroxide reverts to a lower condition of oxidation, while the metallic cobalt is oxidized. Owing to the relative ease, as compared to cobalt, with which mercury and copper reduce, the added mercury or copper, or silver, if used, will be reduced to the metallic state when the battery is first charged, so as to procure good electrical contact between the active cobalt particles. Since the cobalt on discharge oxidizes much more readily than either mercury, copper, or silver, the latter materials remain in metallic form, and their presence serves wholly to assist electrical conduction between the particles of the active material.

"Although it is preferable to add a readily-reducible metal, like mercury, copper, or silver, or a combination thereof, to the cobalt for the purpose of maintaining electrical contact between the active materials, it will be of course understood that any insoluble conducting material, preferably in flake form, such as flake graphite, can be used for maintaining the cobalt particles in electrical contact."

THE HEAVENS IN APRIL.

BY HENRY NORRIS RUSSELL, PH.D.

There is no other season at which so many bright stars can be seen in our latitudes as at present.

At 9 P. M. on the 15th Orion is almost due west, though very low down. His brightest star Rigel has already set, though the ruddy Betelgeuse still flares above.

Aldebaran and the Pleiades shine on the right, while Sirius is on the left. Procyon is above the latter, rather more to the southward, and Castor and Pollux are above Orion, higher still.

Capella lies in the Milky Way in the northwest. Regulus, with the attendant stars of the Lion, is almost due south, with Hydra below him and Ursa Major above. Spica lies well down in the southeast, but is less conspicuous than Arcturus, which is higher up and farther north. Mars, which is about half way between Regulus and Spica, surpasses them both in brightness.

Northeast of Arcturus, beyond Corona Borealis and Hercules, Vega is once more visible, a few degrees above the horizon.

There can therefore hardly be a better occasion than the present to mention some interesting observations that have recently been published by the Yale Observatory, regarding the parallaxes and distances of a number of these stars. As we have recently discussed the methods by which stellar parallax is determined, we need now only state the results of Dr. Elkin's work, translating the parallaxes which he gives into the more intelligible form of distances in light-years.

A light-year (as most of our readers probably know) is the distance which light traverses in a year's steady progress at the rate of 186,000 miles per second. It is about six millions of millions of miles, and is some 63,000 times the earth's distance from the sun, so that, on a map upon which the earth was one inch from the sun, a light-year would be represented by one mile.

According to Dr. Elkin's observations, the nearest bright star in the northern hemisphere of the sky is Procyon, whose distance is very nearly 10 light-years. Next comes Altair, at a distance of 14 light-years, and then Aldebaran, whose light takes 30 years to reach us. Vega and Capella follow, both about 40 light-years from us.

As the stars' distances increase, it becomes more and more difficult to determine them with any approach to accuracy. Dr. Elkin's parallax puts Pollux at a distance of 60 light-years, but the probable error of the determination is such that it is as likely as not that the true distance may be as small as 40 light-years, or as great as 100.

The distance of Arcturus comes out 125 light-years, and those of Regulus and Betelgeuse about 140, but these must necessarily be very rough approximations indeed, as the whole parallax is but 1-40 of a second of arc. Finally, the measures show that Alpha Cygni is actually farther away than the small stars which were chosen for comparison. Its actual distance is unknown, but must be very great—probably several hundred light-years.

We may add that determinations by other observers show that Sirius is nearer than any of the above, its distance being 8½ light-years, and that Spica is very remote—probably 100 light-years; while Rigel seems to be even farther away. The far southern star, Alpha Centauri, which we never see, is the nearest of all—a little over four light-years.

From photographic measurements it is found that the sun, if removed to a distance of five light-years, would appear as a star of about the standard first magnitude. As all the stars above mentioned, except Alpha Centauri, are beyond this limit, they must all be in reality brighter than the sun.

When the differences in their apparent brightness, as well as in their distances are taken into account, it is found that if we take the amount of light emitted by the sun as a unit, then the light of Alpha Centauri is 2, that of Procyon 6, of Altair 8, of Sirius 25, Aldebaran 33, Pollux 100, Vega 125, and Capella 150. The uncertainty of the distances of the remote stars is so great that no reliable estimate of their light can be given; but it seems probable that Betelgeuse and Regulus give fully 500 times as much light as the sun, and Arcturus, Rigel, and Alpha Cygni at least 1,000 times as much, and perhaps much more.

It is very clear that the sun is only an inconspicuous member of the stellar system. But it should be remembered that the stars we have been considering were selected on account of their apparent brightness, so that they are hardly fair specimens of the average of the stars. Some of the fainter stars whose parallaxes have been measured are found to give less than one-hundredth as much light as the sun.

THE PLANETS.

Mercury is morning star until the 12th, when he passes behind the sun and becomes an evening star. At the end of the month he is well placed for observation, near the Pleiades, setting after 8 P. M., and should be easily seen.

Venus is evening star in Aries and Taurus, and is very conspicuous, remaining in sight till after 9 o'clock. She is increasing in brightness, and will continue to dominate the evening sky all summer.

Mars is also very conspicuous, being in Virgo, just past opposition, visible all night, and by reason of his color and brightness, the most notable object in the midnight sky.

Jupiter is morning star in Aquarius, rising at 3:30 A. M. on the 15th. Saturn is morning star in Sagittarius, rising rather more than an hour before Jupiter. He is in quadrature on the 30th.

Uranus is in Ophiuchus, and comes to the meridian at 4 P. M. on the 15th. Neptune is in Gemini and sets about midnight.

THE MOON.

First quarter occurs at 9 P. M. on the 4th, full moon at 4 A. M. on the 15th. Neptune is in Gemini and sets 19th, and new moon at 8 A. M., on the 27th.

The moon is nearest the earth on the 5th, farthest away on the 18th, and nearest again on the 30th. She is in conjunction with Neptune on the 3d, Mars on the 10th, Uranus on the 16th, Saturn on the 20th, Jupiter on the 23d, Mercury on the 28th, and Venus on the 29th.

On the evening of the 11th there is a partial eclipse of the moon, most of which is visible in the United States, though the earlier phases occur before the moon has risen. The moon enters the shadow at 5:34 P. M. Eastern standard time, and, as seen from Washington, rises eclipsed. The middle of the eclipse is at 7:13 P. M., by which time she is visible as far west as Pittsburg. By the time she leaves the shadow, at 8:52, she can be seen from points as far west as Denver; and when she leaves the penumbra, at 10, she is visible throughout the country. The eclipse is very nearly total, as at the greatest phase all but one-fortieth of her diameter is immersed in the earth's shadow.

Cambridge.

SCIENCE NOTES.

An interesting astronomical phenomenon was recently witnessed by M. Flammarion, the famous French observer, at his observatory at Juvisy, in connection with the casting of the earth's shadow on the moon. This phenomenon is sometimes seen in the east at the moment when twilight fades into night. On the occasion in question M. Flammarion noticed that the moonlight, notwithstanding its apparent intensity, was too weak to permit the phenomenon's being seen except by the experienced eye. The immense shadow of a greenish black color ascended slowly toward the zenith. It was a regular circle in form, surmounted by a line of reddish light of weak intensity, arising from the refraction of the light in the atmosphere. Though the sky was generally clear, it was traversed by a large number of small storm clouds, and the presence of the latter prevented the observer's measuring the light, in order to calculate thereby the height of the atmosphere.

An interesting attempt is to be made to locate the magnetic pole by means of a small boat, and a crew of eight men, under the command of Capt. Arundsen. The boat is being fitted out for the expedition at Christiania, and she will depend upon propulsion from both sail and a small naphtha motor, of sufficient power to supply a speed of five knots per hour. She will carry a reserve supply of fuel sufficient for one hundred days' steady use, though of course she will be mainly dependent upon her canvas. The expedition will set out in April next, and it is intended, if possible, to remain in the ice four years. Owing to the diminutive size of the vessel, she will not be able to carry a large supply of provisions, but it has been arranged to obtain further supplies from time to time from the Dundee whalers. A station will be set up and furnished with self-recording instruments, which will collect scientific data. The members of the expedition will make journeys for geographical and other investigations.

The government of the Punjab Province of India has commenced an undertaking which when completed in five months' time will be the largest bacteriological enterprise the world has yet seen—the inoculation of 7,000,000 persons for protection against the plague, the only beneficial course yet discovered to insure immunity from this disease. The superintendent of the laboratory at Bombay is to supply plague serum at the rate of 50,000 doses a day. The serum is being supplied from England in 14,000 flasks, and will entail the manufacture of four huge sterilizers costing $1,500 each, the planning of a new system of pipes and sinks for extra gas, and water, and churns. A very good idea of the prevalence of the disease in India, and the high mortality that accompanies it, may be formed from the fact that in the third week of August there were 3,547 fatal cases. England has now been combating this disease for nearly six years, and no remedy attempted has proved successful except inoculation.

Some fresh data has recently been gathered relative to the great Lisbon earthquake of 1755, when the city was destroyed and 80,000 people lost their lives, by fresh discoveries recently unearthed under the debris of the old city. Evidently Lisbon in former days was rich in costly temples, palaces, tombs and works of art, as the occasional discoveries of the Lisbon Archæological Association testify. Recently a member of this institution observed the capitals of a highly ornate portico projecting, in an excavation, close to the spot where the tomb and remains of an illustrious personage of ancient Lisbon were unearthed in 1900, in the Alfama quarter. Excavations were carried out, a gate forced, and a beautiful mortuary chapel was unearthed, containing the tomb of a young girl, while within the tomb a skeleton clad in a coat of rich brocade ornamented with "glories," or representations of "O Espirito Sancto," was found. The fabric is still perfect in color and fiber, and if proper care is observed it may not deteriorate from exposure to the air. Further investigation has proved that this skeleton is undoubtedly that of the favorite daughter of King Alfonzo, the child wife of Count Henry of Burgundy, grandson of Duke Robert, who fought successfully under King Alfonzo's banner against the Moors in Spain, and was rewarded in 1005 for his services by the monarch, with the hand of his daughter, with Portugal as her dowry.

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VESSELS MADE FROM QUARTZ AND SOME OF THEIR USES.

BY PROF. JOHN TROWBRIDGE.

For many years silk fibers were used to suspend tiny collections of magnets in various forms of galvanometers. At one time this method of suspension had great practical importance, for galvanometers provided with such magnets, placed on minute mirrors, were universally employed in transmitting and receiving messages on submarine cables.

All testing work in laboratories also depended on this use of silk fibers, for the cobweb-like filament permitted the slightest movement of the magnet of the galvanometers. There was, however, always the difficulty of the torsion of the fiber, which resisted the free motion of the magnet while it was under the action of the electrical impulse, and also led to a permanent set or deviation of the magnet from the true position of rest after the electrical action had ceased.

Prof. Boys was the first to suggest the use of quartz fibers for delicate suspensions in the place of cobwebs or silk fibers. This suggestion has led to a remarkable improvement in electrical testing apparatus; and in all forms of physical instruments in which suspensions free from torsion are necessary. The method employed by Prof. Boys, and followed by others, is to fuse pieces of quartz in an oxyhydrogen blowpipe until a fairly large piece of amorphous silica is obtained. An arrow or dart is then made. One end of the dart is provided with a sharp iron point; this is the head of the arrow. A piece of elastic is attached to a board, the ends about three feet apart. A piece of the fused silica is tied to the blunt end of the arrow; another piece of this silica remains upon the operating table. The arrow is drawn back from the board a suitable distance. The two pieces of quartz are fused together in the blowpipe and the arrow is discharged, carrying with it an extremely fine thread of the fused silica.

These threads can be twisted many hundred times without showing torsion, and magnets suspended by them return absolutely to their position of rest. This amorphous silica has also another still more remarkable property, and the method of preparation has made it resemble a metal.

Some remarkable advances have been made lately in the employment of quartz for vessels capable of withstanding very high temperatures without cracking. It is well known that glass vessels must be annealed with the utmost care in order to resist sudden changes of temperature. A glass blower cannot put aside a piece of glass which he has heated without first tempering it in a smoky flame. Now vessels are made of quartz which can be heated to a white heat and while in this condition can be plunged into cold water without suffering the slightest injury.

The discovery of the new manipulation of quartz is due largely to Prof. Shenstone, of Bristol, England, and the method he employs is as follows:

Pebbles of Brazilian quartz are heated to a red heat or even higher in a muffle furnace. They are then thrown into a vessel containing distilled water. The cleanest and purest pieces are selected and welded by means of the oxyhydrogen blowpipe into long pieces like knitting needles. The quartz has now completely lost its crystalline character, and is not quartz, but amorphous silica. It has acquired the remarkable property of resisting extremely sudden changes of temperature, and vessels of any shape or size can be made from it. Time and money are the only considerations. Fig. 1 shows vessels of different sizes and shapes which I have obtained by this process. The photograph represents them half the original size. The needle-like pieces are also shown. The tubes are built up from these. In the test tube, for instance, which is represented in the photograph, a white-hot coal can be dropped without breaking it; it also can be heated to a white heat and then filled with cold water without cracking.

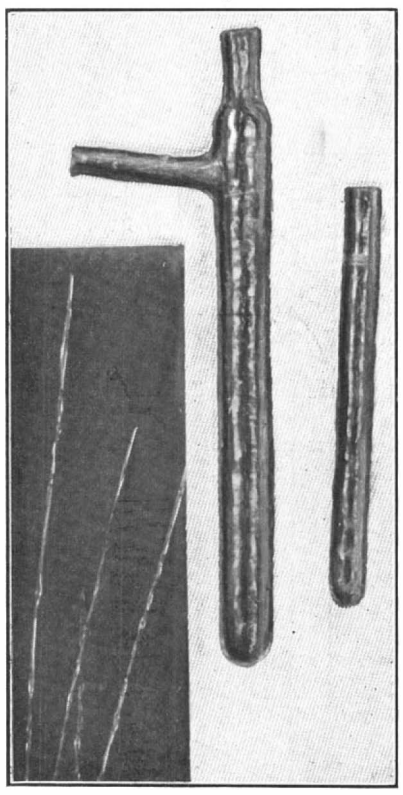


Fig. 1.—NEEDLE-LIKE PIECES OF AMORPHOUS SILICA, AND THE TUBES BUILT UP FROM THEM.

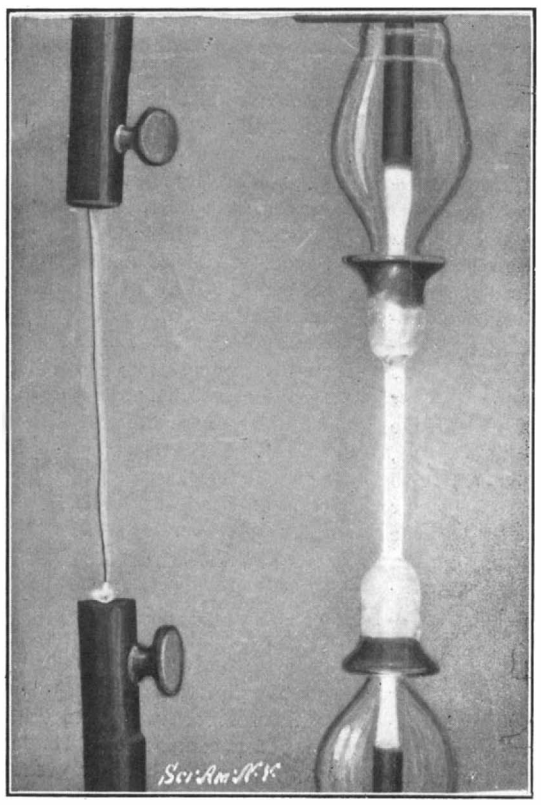


Fig. 2.—SPECTRUM TUBES MADE FROM AMORPHOUS SILICA.

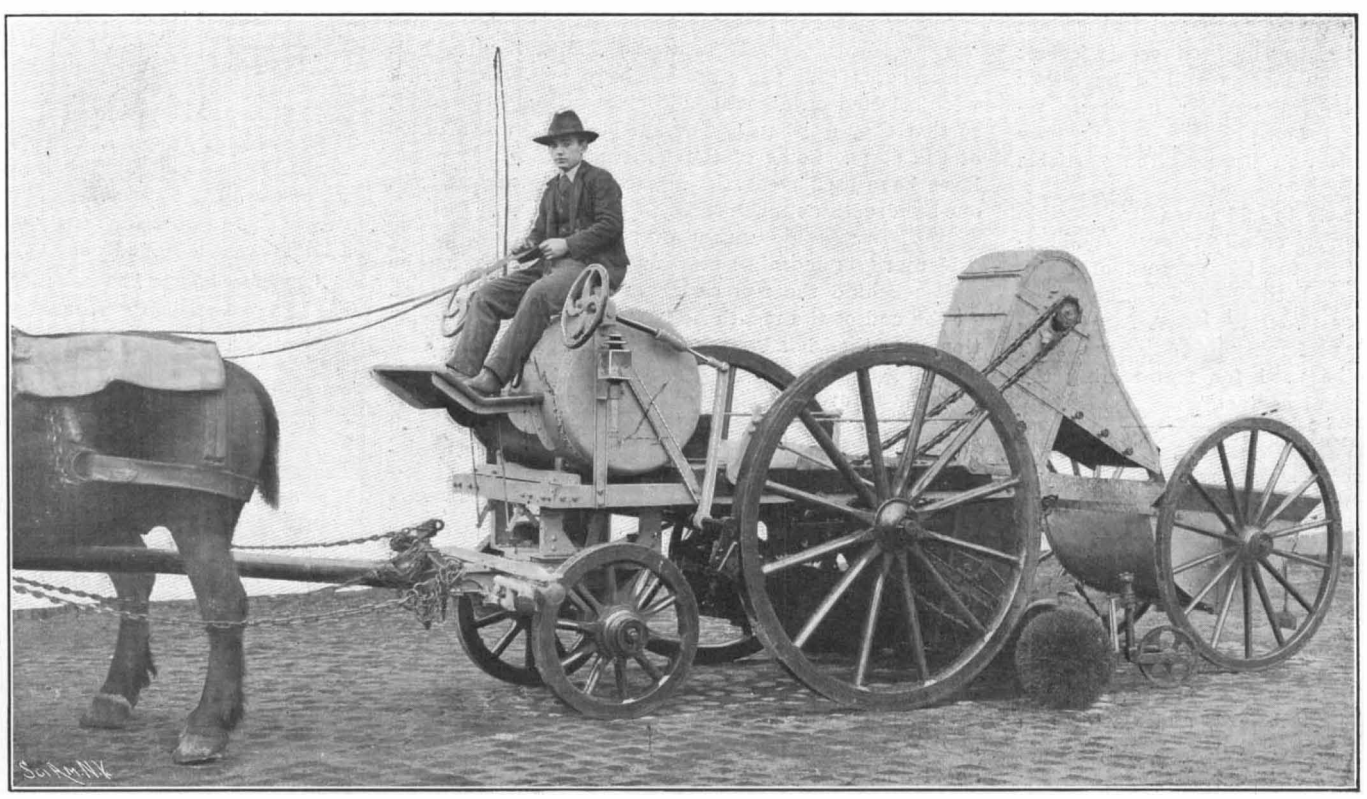
Fig. 2 shows spectrum tubes made for me from this amorphous silica. This tube was filled with hydrogen; a piece of iron wire No. 36 gage was placed in the same electric circuit. The quartz tube is illuminated by its own light, which is the most powerful artificial light which has ever been obtained. The duration of this light, in this case, was only one hundred-thousandth of a second. The iron wire is shown intact, although no trace of it could be found after the discharge. It took a comparatively long time to melt the wire, and this was accomplished when the light had entirely died out from the tube. These quartz tubes have proved of great importance in my work on hydrogen gas submitted to very high temperatures. Glass spectrum tubes speedily cracked or disintegrated under the powerful electrical discharges, but the quartz tubes withstood this high temperature without the slightest corrosion of the inner surfaces. By their use I have discovered new gaseous spectra which seem to me to be of great importance in regard to various speculations in regard to the changes going on in the sun and other heavenly bodies. When glass spectrum tubes are employed, various lines appear which some have attributed to the impurities coming from the glass. Most glass, for instance, contains the metal calcium; and two very strong calcium lines fall on the two most marked lines of the solar spectrum—the so-called great HH lines. When hydrogen is submitted to strong electrical discharges in glass tubes, two strong lines appear, which are also coincident with these great solar lines; and they have been therefore attributed to the calcium coming from the glass. The use of quartz tubes, however, shows that these lines are gaseous and that the gas is also contained in the earth's atmosphere. The lines may be due to hydrogen or to an unsuspected gas. I am now investigating this question.

The quartz tubes also allow the study of the invisible violet portion of the spectrum of hydrogen, for quartz permits the passage of rays which glass completely intercepts. A new region of gaseous lines is thus opened which has never before been brought to light. Under strong electrical discharges hydrogen shows dark lines as well as bright lines. These dark lines are due to a reversal on the photographic plate, and the phenomenon is of great importance in speculations on the nature of the changes which are occurring on the sun and in the variable stars.

A MECHANICAL STREET CLEANER.

The disadvantages of all those methods of road cleaning which involve the direct removal of dry dust and refuse are so obvious that it is scarcely necessary to point to them. Of the innumerable microbes which are set floating through the air by the brush drawn over dry ground, quite an alarming number must be carried into the respiratory organs of animals and man, not to mention the multitude which in one way or another reach vulnerable points of the system, after being whirled into the air with the dust.

Various ways of avoiding these evils have been proposed and put to the test. One machine designed to effect this and also to clean the road, was exhibited in the Public Health section of the recent Düsseldorf exhibition. The plan adopted is to sprinkle the road before the brush is sent over it, and to collect automatically the mud gathered by the brush. We reproduce a view of this machine, which will help to make clear its construction. The machine, which is called the "Salus" street cleaner, is mounted upon two pairs of large wheels and a pair of small wheels in the front truck. Above this latter is lodged a water tank of about 200 gallons capacity, and on this again is fixed the driver's seat. Within easy reach of the driver is a tap which controls the flow of water to the sprinkler, and a wheel, by turning which he can at will raise or lower the broom. This latter consists of two stiff portions at the sides, connected in the middle of a flexible piece, which is kept curved, with its convexity toward the back. A combination of gear wheels and sprocket chains transmits the rotation of the axle of the center pair of carriage wheels to the broom. Owing to the curved form of the broom the mud is driven in toward the middle, collecting there upon a platform, which grazes the ground just in front of the brush, until it is forced along by a scraper. The action of this scraper is such as to rake the mud periodically upon the platform toward a bucket chain, which is also driven from the middle carriage axle. This chain lifts the mud and



AN HYGIENIC STREET-SWEEPING MACHINE.

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deposits it in a tank carried upon the rearmost pair of wheels.

When the machine is traveling at a rate of three miles per hour, the broom makes 91 revolutions per minute, and each bucket of the chain pump makes 4.8 journeys up and down per minute. The breadth of road sprinkled is about 8 feet. The sprinkler is found to be thoroughly efficient in preventing any dust rising even in the driest weather. The bristles of the brush are so chosen that the machine works without clogging on snowy ground. Any danger of obstruction of the chain pump is avoided by the comparatively small number of brackets. It has been estimated that two machines of this type, working one behind the other for 7 or 8 hours a day, perform the same work as 20 men working for the same length of time. Each machine requires one driver. A disadvantage is perhaps to be found in the weight of the machine, which is considerable, but which has of late been somewhat reduced by the simplification of certain parts.

ELECTRICITY IN MODERN MINING DRAINAGE INSTALLATIONS.

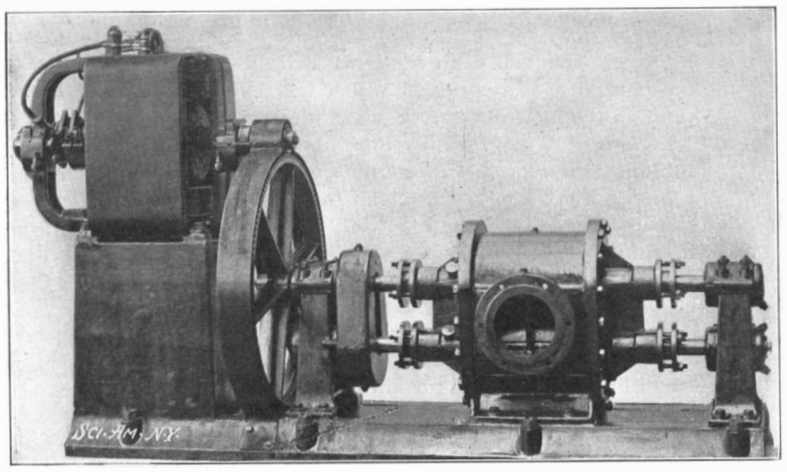
BY FRANK C. PERKINS.

The drainage of mines by electrically operated pumps has now reached a stage of reliability and economy in America as well as in Europe. It was necessary on account of the size of the shafts to construct the pumps and motors in parts which could be easily transported through these shaft openings and drifts. It was necessary for both the pump manufacturers and electrical manufacturers to make concessions in the speed limits of their products. The polyphase induction motors for mining pumps are reduced in speed for direct connection, and the design of the pumps now provides as high speeds as possible. The pumps designed by Prof. Riedler and the engineers of Ehrhardt & Sehmers, as well as those of the Breslau Engineering Works, of Europe, are operated at from 100 to 300 revolutions per minute and are highly efficient for mine working.

An electrically operated mining pump at Planitz has a Siemens & Halske alternating current motor placed at the center of the crank shaft with one plunger at each end, while in the case of the pump at the Ferdinand mine the motor stands on one side of a twin pump. The Planitz pump has a capacity of one cubic meter of water per minute at 145 revolutions per minute, the height of lift being 250 meters. A liquid starter is used with this alternating current motor. The capacity of the twin electric pump at the Ferdinand mine is 1.5 cubic meters per minute at 184 revolutions per minute, the head being 200 meters. At the latter mine there is also in use a much larger electric pump driven by the same type of motor direct connected at the side of a triple pump which has a capacity of 5.5 cubic meters of water per minute at a speed of 146 revolutions per minute, the height of lift being 300 meters.

Taking the efficiency of the dynamo machines, electric cables, and electric motors as tested at 93, 97, and 93 per cent respectively, the useful efficiency of the complete electrical plant is 83 per cent. The high speed pumps have an efficiency of 83 per cent and steam engine 85 per cent, so that the net useful efficiency of steam engine, generator, line, motor, and pump would be 50.5 per cent. The loss of condensation and leakage in a long steam pipe is very large and the steam must be kept up, while in case the electric pump is stopped for short periods no current is being used. The electric mine drainage plant is therefore of higher efficiency and has greater reliability with lower working expenses than hydraulic, steam, or compressed air systems.

The Helios alternating current motor mining pump in the underground installation at Germania I. mine of the Gelsenkirchener Bergwerks-Aktiengesellschaft,



A JAEGER ELECTRIC ROTARY PUMP.

consists of a 160 horse power Drehstron motor mounted between the plungers of a compound twin pump. This pump was constructed by the Maschinenbauanstalt Breslau on the Bergman system, and it has a capacity of 3 cubic meters of water per minute under a head of 160 meters. The polyphase motor built by the Helios Electricitats Aktiengesellschaft of Cologne-Ehrenfeld, operates at a speed of 180 revolutions per minute and is connected directly to a 2,200-volt three-phase circuit.

The Rateau-Gruben ventilator of the Germania II. mine is operated by a 400 horse power motor of the three-phase type. This great ventilator is directly coupled to the motor, which runs at a speed of 238 revolutions per minute and is driven from the same 2,000-volt alternating current circuit directly without reduction by transformers.

At the electric drainage installation carried out for the Hösch Steel Works at the Kaiserstuhl II. shaft at Dortmund a 750 horse power three-phase motor mining pump was installed by the Maschinenfabrik Oerlikon of Oerlikon, near Zurich, Switzerland. The motor frame of this machine is about 14 feet in diameter and 900 millimeters in width. The motor operates at only 75 revolutions per minute on a pressure of 19,000 volts. The present working of the electric pump requires it to raise five cubic meters of water per minute from a depth of 300 meters, but the outfit is designed to raise the same quantity of water at full load a height of 400 meters. The over-all efficiency of this pumping plant between the indicator and the water pumped to the shaft mouth when the steam engine was fully loaded amounted to from 65 to 67 per cent, which may be considered remarkably good.

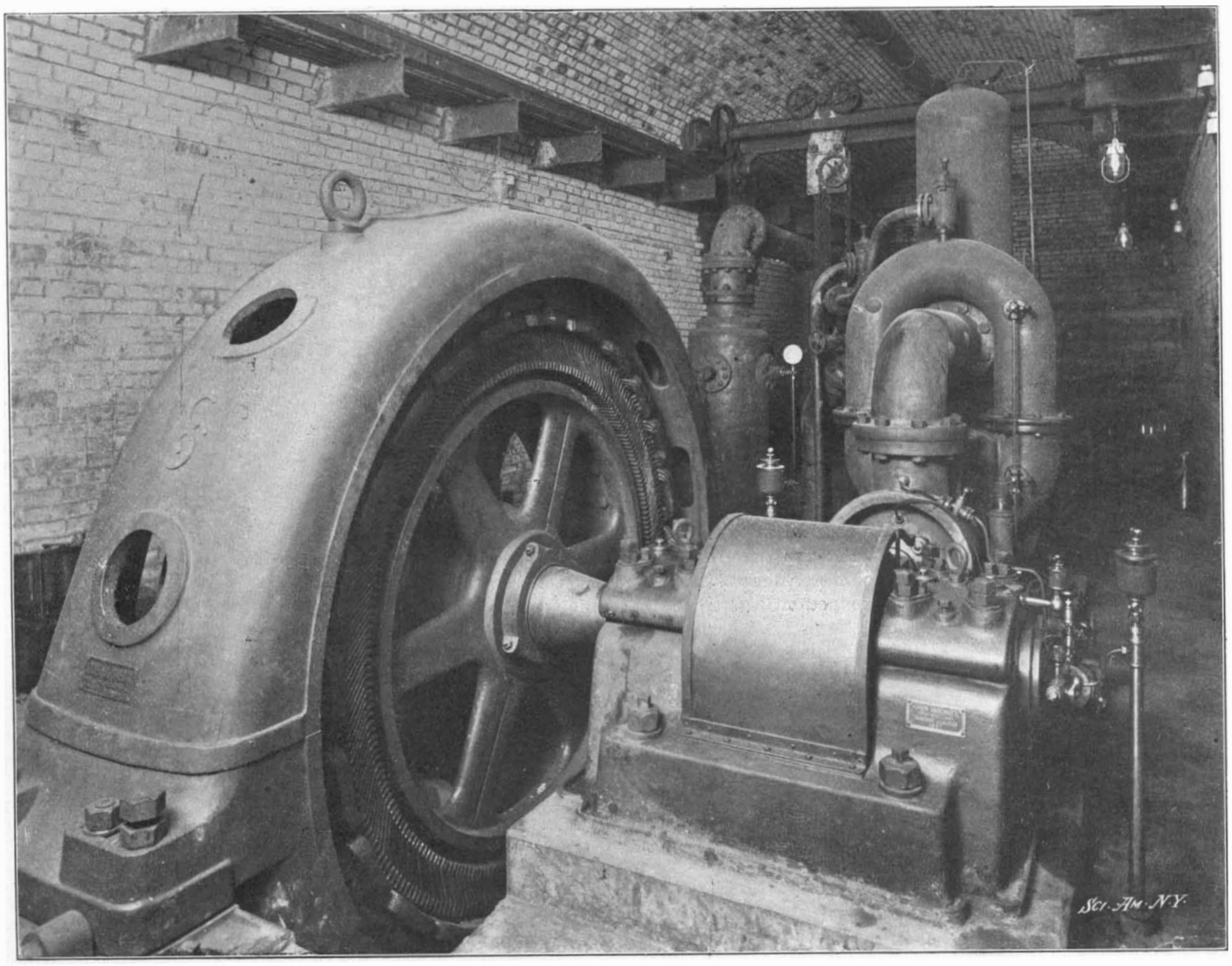
The high power mine pump working by electric power in Germany and throughout Europe has been carefully worked out and the alternating current slow-speed induction motors of the polyphase type have done remarkably well in this service.

The underground electric pumping plant of the Glückauf shaft of the Zwichauer Steinkohlenbau-Vereines was installed by the Schuckert Company of Nurnberg. There are two Bergman Zwillingpumpe, each directly connected to a 220-volt three-phase motor. These motors operate at a speed of 180 revolutions per minute and are supplied with current directly from the 2,000 volts polyphase power transmission line, although other machinery driven by electric motors in the mine has the current transformed down from 2,000 to 500 volts. In this plant, as well as nearly all of the large electrically operated mining plants in Germany, a large, well-equipped, and economical power plant is installed above ground for supplying the necessary power for use in the mines.

Many of the mines of England are operated by electric power. Large numbers of electric hoists, pumps, cutters, and auxiliary mining machinery have been supplied by Ernest Scott & Mountain, Limited, and their prominent engineers. In England as well as in America and on the Continent of Europe direct-current motor-driven pumps of both plunger and centrifugal types are in use with both open and closed or iron-clad motors according to the location and their liability to be subjected to moisture and rough usage.

The rotary pumps of C. H. Jaeger & Co., of Leipzig-Plagwitz, are extensively used abroad, and in the American mines the Worthington, Blake-Knowles, Deane, Goulds, and Allis-Chalmers types are commonly employed. The Risdon duplex and triplex electric pumps manufactured in San Francisco are largely used in the western part of the United States. They are double geared to reduce the speed and two motors are employed, as it is found impossible frequently to get very large machines down existing shafts. Where a special shaft for mine pumping is made, large motors are preferable, as they have much higher efficiency as well as lower speeds. Three Risdon electric triplex pumps driven by induction polyphase motors have been recently placed in an underground station with a capacity of 6,000 gallons per minute, the water being raised 1,000 feet. An extra large underground chamber is required for pumps of this character but with large motors there is greater economy of space.

At an ironstone mine in Yorkshire, England, which had been flooded, an electric pump of the centrifugal Scott & Mountain type was used. It was designed to deal with 1,000 gallons per minute against a head of 150 feet and ran at a speed of 700 revolutions per minute, a 100 horse power motor being used. The mine being flooded and the dip 3 inches to the yard, and it being necessary to have the pumps portable, this type of plant was suggested. In practice the electric pumps were lowered each 80 yards, which at 3 inches to the yard is equivalent to a suction of 20 feet vertical head. The inlet and outlet branches of the pump consisted of flexible rubber pipes, the total length over flanges being 27 feet, so that the raising main was laid as the pumps were gradually lowered. After each lowering of the pumps three 9-foot lengths of pipe took the place of the positions where the electric pumps operated, the suction pipes then forming



SIEMENS-HALSKE ALTERNATING-CURRENT MOTOR DRIVING A MINING-PUMP IN AN UNDERGROUND INSTALLATION.

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the rising main. For English electric pumps operating under heads from 500 feet to 1,000 feet double gearing is very largely used.

On one colliery in the North of England a large quantity of water had to be pumped underground by dip pumps. The company originally drove the pumps by wire ropes from engines at the pit bottom. The existing pumps were converted into electric pumps driving through machine worm gearing from the motors to the pumps, eight outfits being equipped each with 6 horse power motors. It is stated that the annual saving of the electric over the old method of pumping, after allowing for interest and depreciation, was such that the electrical machinery paid for itself in three years.

It is generally recognized as a fact beyond question that electricity is the most economical and convenient form of motive power for mine haulage and hoisting. It is especially suitable for pumping and ventilating installations on account of its flexibility, permitting ready extension and change as mining conditions frequently require.

During recent years the polyphase power transmission system has been introduced extensively and has been found to be a valuable means of supplying the necessary power for mining operations. Where the several shafts of a mine are located more than a mile apart, the latest practice is to establish a main generating station near one of the main shafts where sufficient power is generated to supply the entire mine including all of the shafts. The two-phase or three-phase alternating current is generated at high potential directly by the generators, or the potential is raised by step-up transformers for transmission and again reduced in pressure at the various shafts for distribution in the mine.

From the sub-stations at each shaft highly insulated lead covered and armored cables conduct the current to the electrically driven drills, ventilators, pumps, and hoists. While at present the direct current is considered most practical for electric mining locomotives, the polyphase machines are coming into use rapidly and are growing in favor. The present necessity in some mines of having direct current for use with certain classes of electrically operated mining apparatus is met at polyphase installations by providing rotary converters at the sub-stations or motor-generators, changing the alternating current to a continuous current of any desired voltage wherever required.

The polyphase system has been in operation with great success at the mines at Karwin. The main generating station is located at the Hohenegg shaft, where there are in operation an electrically operated pumping plant, 110 horse power ventilator, and hoisting apparatus. For supplying current to the Albrecht shaft at Peterswald, more than three miles away, and the Gabriel mine at Karwin, the current is raised to 10,000 volts pressure and reduced in voltage again at the shafts.

Typhoid Fever Serum.

A typhoid antitoxin serum invented by Dr. Allen Macfayden and indorsed by no less a person than Lord Lister is the latest medical discovery. Dr. Macfayden is the Director of the Jenner Institute of Preventive Medicine. Briefly stated, Dr. Macfayden's discovery consists in this: He has found that by crushing the cells of the typhoid bacillus in liquid air, the intercellular juices are not only obtained without living organisms, but are also rendered highly toxic. When injected into living animals, these juices produce a blood serum which acts as an antidote against the poison generated by the typhoid bacillus. The novel feature in this process is the use of liquid air, the function of which is not fully understood as yet.

A Prophecy of the Failure of Our Coal Supply.

In a lecture before the National Geographical Society, Prof. C. D. Walcott, Director of the United States Geological Survey, said that the anthracite coal fields of the United States would be exhausted in sixty years at the present rate of consumption and that by the year 2203 the bituminous coal fields will also be worked out. After this the country will be compelled to secure its fuel supply from the lignite beds of the West.

A Bacteria Safety Lamp.

News has been received from abroad that Prof. Hans Molisch, of Prague, has discussed a new use for bacteria. In a communication to the Vienna Academy of Sciences, he described the specifications of a mining lamp, the light of which is supplied by luminous bacteria. The lamp consists of a glass jar lined with a compound of saltpeter and gelatine previously inoculated with bacteria. In the culture thus constituted, bacteria developed prodigiously, in two days causing the jar to be illuminated with a bluish green light which lasted for several days and gradually disappeared in about a fortnight. The light is cold and harmless. Faces can be recognized, it is said, for a distance of two yards and large type can be read by it.

Automobile News.

The International Gordon-Bennett cup race, which was run last year as a part of the Paris-Vienna contest, will this year be held in Ireland on a circular course. The total distance to be covered is 131 miles. The race will be started in the early morning hours of July 9. America is to be represented, for the first time, by a team of three chosen by the Automobile Club from among the winners in some competitive trial races, which will take place the middle of April.

The Automobile Club of Great Britain has planned an endurance run for 1903 which will be more severe than anything ever before attempted, says the New York Sun. It will literally test the limit of reliability, for no stops whatever are to be allowed for, and an operator may not even clean his vehicle. Every minute spent in examining, oiling, or in any way touching the machine, except to regulate its speed and guide it, will be penalized. The run will be one of 1,000 miles and will be run on successive days, starting and finishing at Crystal Palace. When an operator starts out he will take an observer with him who will make the notes that will cost him marks. Not even punctures or blocked roads or railroad gates will be accepted as non-penalizable causes. Every one must take his chances. When the machines come in at night, the operators must jump out and leave them without doing a thing. The club's stewards will take charge of the competing vehicles at the gate of the garage. If the machine must necessarily be oiled or tinkered, the operator must do it in the morning and be penalized one mark for every minute he spends at it. He positively must not wash off the mud. Automobilists in New York are inclined to think that the time is now ripe for some arduous test of this sort in this country, according to what a couple of them said recently.

In the present stage of the development of the automobile, the pneumatic tire is the weakest and most unsatisfactory part of the vehicle. The cost of tire repairs and replacements is frequently the heaviest running expense of the vehicle, while the delay and inconvenience often caused by the failure of a tire cannot be measured in money. This is especially true of the large and expensive tires used on the heavy, fast machines, which wear most rapidly and are most costly to replace. These tires cost from $40 to $79 each, a set of four costing from $160 to $316. A set for a light carriage of the runabout type costs from $50 to $80, so that the expense of these very necessary parts of the vehicle is apparent. Of late, says the N. Y. Times, the experiment has been tried of substituting solid tires on the rear wheels for the pneumatic ones, and the results are said to have been very satisfactory. The vibration was not increased to an uncomfortable degree, and the tractive force of the vehicle, especially on a hill, was much increased. Hills which could not be climbed with a vehicle fitted with pneumatic tires on all four wheels, were surmounted when solid tires were placed on the rear wheels. It is believed by persons who have studied the matter that there are but two solutions to the problem. One is to make the pneumatic tire absolutely puncture proof by using a metallic or otherwise protected tread, and the other is to substitute a mechanical device between the frame and the body of the vehicle which will take up all the jars of the road. Much work has been done along both lines, but without success so far.

An important congress has been held in London by the officials of the various great trunk railroads of Great Britain relative to the adoption of electric traction upon their different systems. The most important point discussed was concerning the position of the current rail in connection with the ordinary two rails, its distance therefrom, height, and position. As electric traction for trunk railroads is on the eve of introduction in Great Britain this congress was assembled to prevent various standards being adopted upon the different systems, which would thus seriously interfere with intercommunication between one company and another to the detriment of their welfare and traffic. By the adoption of one standard common to all the railroads, electric locomotives and trains could be as easily run over various systems as the present steam locomotives achieve the same object. Those railroads which are already introducing electric haulage upon certain sections of their roads are adopting different standards according to the amount of space available for the placing of the current rail, and although the difference is only a matter of one or two inches, yet it is of vital importance that they should adopt measurements which will be easily applicable to the other systems. This step is imperative, as Mr. Yerkes' electrification of the London underground railroad is in progress, and, as the trunk railroads have running powers thereon, the latter will have to adopt electric locomotives, since no steam locomotives are to be permitted in the tunnels after the conversion to electricity is completed.

Engineering Notes.

The ore-carrying trade of the past season on the Great Lakes was the greatest ever known, and active preparations have already been commenced for a still greater one next year, when the total tonnage will, it is anticipated, reach 29,000,000 or even 30,000,000 tons. The United States Steel Corporation is about to place an order for twenty of the largest ore-carrying vessels ever constructed, each with a capacity of 9,000 tons. Orders have been given to double-track the line of the Bessemer Railroad from Conneaut to Bessemer. This line is controlled by the Carnegie company.

A new type of file, specially devised for working upon gun metal, has been introduced into the engineering department of the Chemin de Fer du Nord, France. The feature of this tool which distinguishes it from the general type of file, is a series of shallow channels which cross its face diagonally at an angle of 30 deg. and placed about half an inch apart. The raised portions of the surface of the file between these channels are occupied by the teeth of the tool. The advantages of the file are that it clogs less rapidly, and can easily and quickly be resharpened on the sand-blast, while it increases the work of the engineer who uses it in connection with gun metal filing, by 30 per cent.

Almost every day brings forth some evidence of the extreme durability of the pressed steel car. A few days ago in Pittsburg, one of these cars while being shifted was sent down a track which ran close to a stone wall of very substantial construction in the Panhandle freight yards. The brakes failed to work at the proper time and the car crashed into the bumper with terrible force. The upper part of the car was forced over the bumper against the stone wall, which was cracked in four places and which had every appearance of being ready to fall when it was taken down. The car was not seriously damaged and on being placed on the tracks again was able to resume its trip without any attention whatever.

The new rail mill at Ensley, Ala., has been recently started, and the announcement is made that it is ready to take orders for immediate and future delivery for basic open-hearth steel rails. The operation of this mill is part of a gigantic industrial programme which has been carried out at this point by the Tennessee Coal and Railroad Company, and it indicates a great stride in the advancement of the iron and steel industry of the South. Ensley, which is practically a suburb of Birmingham, is now one of the most promising towns of the South, a considerable population having been attracted to the place by the extensive steel and iron works which have been established there within the past few years.

The Transport comments upon the failure of German locomotive manufacturers to fulfill expectations as to time of delivery of locomotives for the East Indian Railway. The reasons put forward by Indian railway companies for giving locomotive orders to German instead of English builders was quicker delivery and saving in cost. The latter is considered a relative term, and the truth of it cannot be tested until the foreign locomotives have been at work. The other reason has proved to be fallacious. In September, 1901, the East Indian Railway ordered forty engines from a German firm, which were to have been delivered in August, 1902, on the ground that thirty-nine weeks and £30,000 would be saved. The fact is that up to the middle of October none had been delivered at all, and completion of the contract is not expected until the end of the year. A year ago the Assam-Bengal Railway ordered ten engines from Germany, to be delivered in April, 1902, but not one of them has yet been delivered; nor were the twenty-two German engines ordered by the Bombay, Baroda & Central India Railway delivered within the forty-two weeks promised.

Modern Machinery contains some interesting facts about the minuteness of some of the screws made in an American watch factory. It takes nearly 130,000 of a certain kind to weigh a pound. Under a microscope, they appear in their true character—perfectly finished bolts. The pivot of the balance wheel is only one two-hundredth of an inch in diameter, and the gage with which pivots are classified measures to the ten-thousandth part of an inch. Each jewel hole in which a pivot fits is about one five-thousandth of an inch larger than the pivot to permit sufficient play. The finest screw for a small-sized watch has a thread of 260 to the inch, and weighs one one-hundred-and-thirty-thousandth of a pound. Jewel slabs of sapphire, ruby or garnet are first sawed into slabs one fiftieth of an inch thick and are shellacked to plates so that they may be surfaced. Then the individual jewels are sawed or broken off, drilled through the center, and a depression made in the convex side for an oil cup. A pallet jewel weighs one one-hundred-and-fifty-thousandth of a pound; a roller jewel a little more than one two-hundred-and-fifty-six-thousandth. The largest round hairspring stud is four-hundredths of an inch in diameter and about nine-hundredths of an inch in length.

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Correspondence.

Marginal Efficiency in Warships.

To the Editor of the SCIENTIFIC AMERICAN:

I wish to say a few words regarding a subject which I do not think has received the attention it deserves among naval architects. I refer to marginal efficiency in warships, which we may define as the ability of a ship to maintain her fighting efficiency against improvements in armor and ordnance. Fighting efficiency is here limited to the ability to give and withstand hard blows. Hence all-around efficiency must include marginal efficiency, speed, bunker capacity, seaworthiness, etc.; and it follows that, other things being equal, the ship with the highest marginal efficiency is the best type of fighting craft and the most economical investment. We may illustrate the practical working of the theory from past experience.

Ten years ago we placed 8-inch B. L. rifles on the "Oregon," while contemporaneous foreign craft carried no medium-caliber guns larger than the 6-inch. To-day, owing to the introduction of the Krupp process, the latter weapons cannot penetrate casemate armor of moderate thickness at the ordinary battle ranges, but the "Oregon's" 8-inch guns, with smokeless powder charges, are still equal to the task. The "Oregon's" marginal efficiency was good, while the foreign ships had none. With this illustration as a basis, we may proceed to define the limits within which marginal efficiency holds good.

I think we may safely assume that the narrower the theory, the easier will be its practical application. Hence I propose to limit it simply to side armor and guns of medium caliber. Nearly all first-class, armored ships mount two or four guns of from 9 to 12 inches bore. Furthermore, water-line protection has advanced so far that "it is only by luck or by indirection that a modern battleship can sink another by gun fire alone." For these reasons we may banish belt armor and the heaviest turret guns to the broad realms of all-around efficiency. Since the province of gun fire is practically confined to the destruction of gun positions and gun crews, the protection afforded the major portion of the factors is of the greatest importance. This "major portion" is undoubtedly concentrated behind the side armor above the belt, and its offensive power is centered in the medium-caliber guns of the main battery. Here, then, marginal efficiency comes into play.

As regards ordnance, I would set the highest marginal limit at the 8-inch, 50-caliber rifle; and the lowest at the 6-inch, rapid-fire of 3,500 foot-seconds muzzle energy. To exceed this limit involves an excess of weight and clumsiness on the one hand and a deficiency of penetrative power on the other. For correlative reasons I would set the maximum thickness of side armor at 7½ inches (Krupp) and the minimum at 6 inches. On a given displacement, of course, it is necessary to strike a balance somewhere between these limits of ordnance and protection, and the skill of the naval architect will appear in his ability to do this. If, for the same weight that gives us a battery of sixteen 6-inch rapid-firers protected by 6 inches of armor, we may have eight 7-inch guns protected by 7 inches of armor, it is apparent that in a duel at a range of 2,000 yards the 7-inch aggregation would be victorious, and hence would have the greater marginal efficiency. From this it will be seen that the improvements which govern marginal efficiency are not limited to new inventions, such as, for instance, smokeless powder and Krupp armor. Structural changes are of importance. The introduction of the so-called "box battery" has nullified the marginal efficiency of the English ships which carry their guns in a number of single casemates. Similarly, ships which offer no protection against shells that might enter and burst underneath their gun positions cannot be said to possess marginal efficiency. Such vessels, however, are not necessarily inefficient, for "et tu quoque" tends to equalize matters.

Protected cruisers have no marginal efficiency. The present type of armored cruiser has little, if any. It might easily be obtained in this class of vessels by improvements on the design of the "Vittorio Emanuele." If, by raising that ship's displacement to 14,500 tons, she could be provided with sufficient side armor to obviate the bursting of 6-inch shells underneath the turrets on the main deck, her marginal efficiency would be excellent. A comparison of such a craft with our own "Tennessee" emphasizes what has been said above, namely, that with other things equal, the ship with the highest marginal efficiency is the best fighting machine and the most economical investment. In this case "other things" would be just about equal. But at the ordinary fighting ranges the "Vittorio Emanuele's" 8-inch shells would go crashing through the "Tennessee's" 5-inch side armor, while the latter ship's 6-inch rapid-fires would be absolutely ineffective against the Italian's gun positions. Moreover, the "Vittorio Emanuele's" 8-inch rifles give her a substantial margin of power as an offset to the next improvement in armor. The same cannot be said of the "Tennessee's" 6-inch rapid-firers.

Marginal efficiency demands that we should be as forehanded as possible in the matter of improvements. For this reason it would seem to be a short-sighted policy which limits the length of our present 7-inch guns to 45 calibers. In the natural course of ordnance development, the 50-caliber, 7-inch rifle is bound to appear. We should increase the marginal efficiency of the "Connecticut" and "Louisiana" by giving them guns of this length of bore. Furthermore, it would be expedient to banish the 6-inch rapid-firer from the batteries of our armored cruisers; for, according to our assumed standard of efficiency, that weapon constitutes the lowest marginal limit, and against adequate protection its rapidity of fire is of no avail. It is poor economy to build ships costing about $7,000,000 apiece, only to have their fighting powers heavily discounted by a comparatively slight advance in the development of armor and ordnance.

In conclusion, it would be well to note that the submerged torpedo is a powerful auxiliary to marginal efficiency. In the last stages of a hard-fought engagement, a fast battleship might resolve herself into a torpedo boat, and in this manner accomplish what she could not do by weight of gun fire alone. The absence of torpedoes on our latest ships renders them particularly liable to this form of attack. It is earnestly to be hoped that in future designs the defect will be remedied.

PAUL D. ERMMONS.

285 Meridian Street, East Boston, Mass., February 2, 1903.

The Naming of Battleships.

To the Editor of the SCIENTIFIC AMERICAN:

I have not seen in your paper, or any other, any reference to the absurd blunder made in naming the four coast defense monitors recently built for the navy after the States.

It is also a mistake though not so bad a one, to name the eight armored cruisers now building for the States.

The result is that only eight or nine names of States are left for future battleships, and these will be used up in two or three years at the present rate of building.

As none of the armored cruisers have been launched, it is not too late, I suppose, to have their names changed to that of large cities, corresponding to the "New York" and "Brooklyn."

In the case of the monitors the Indian names like our present monitors would have been admirably suited to them.

Is it not possible to correct both these blunders by immediate agitation?

J. PICKERING.

Salem, Mass., March 10, 1903.

The "Esmeralda" and the "Charleston."

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your last issue remarks on cruisers by Mr. Daniel M. Coffin, Jr., in which he compares the Elswick-built "Esmeralda" to the U. S. S. "Charleston;" and I would like to say that while I am a very great admirer of Armstrong's designs, yet to a certain extent some of their vessels seem to me to partake of the nature of "freak" ships. I perfectly agree with your remarks on the subject, viz., that to rightly compare two vessels one must not only take into consideration the four great essential qualities, speed, radius of action, gun power and defensive armor, but, also, as you say, we must take account of stores, ammunition, gun mountings, ability to handle ammunition quickly. I might add structural strength and the best possible model for the best possible ship in a seaway.

One vast superiority the "Charleston" would have over the "Esmeralda" would be her ability to fight her batteries in a heavy sea, affording as she does a much steadier platform for her guns; whereas the "Esmeralda" must in a seaway be a very wet ship. A ship with the proportion of beam to length of the "Charleston" class would be, or ought to be, a much more weatherly ship than the "Esmeralda." Then again, as you have pointed out, most of the "Charleston's" heavy guns are behind armor, whereas the "Esmeralda's," all being in open battery, in a close action would soon be completely disabled, even by common shell. Speaking of British ships being undergunned, I must admit that they all, or at least some types, are. But in the line of armored cruisers, I don't think it can be said that the "Black Prince" and "Duke of Edinburgh" class are. These ships are the first that have been designed by Mr. Watts, the new chief designer, since the resignation of Sir William White, and they show a marked change. Their dimensions, etc., are as follows: Length on water line, 500 feet; beam, 73 feet; mean draught, 26 feet; displacement, 13,500 tons; speed with 24,000 indicated horse power, 22½ knots. They are to be armed with six 9.2 B. L. 45-caliber guns, ten 6-inch Q. F. guns, besides the usual number of 3-inch and machine guns, placed as follows: one each 9.2 fore and aft on the axis of ship in an armored turret; the other four on each bow and quarter in turrets, and the ten 6-inch in a central battery. The armor on turrets will be 7-inch Krupp. The side armor of central battery extends in width from 5 feet below water line to the main deck, thus forming a continuous protection for 6-inch guns with splinter bulkheads between. It can thus be seen that these are very powerful ships, and cannot be called under-gunned. I might also say that the battery is all quick-firing, as three rounds per minute have easily been fired from 9.2-inch guns under strictly service conditions, and as many as four and five rounds per minute have been obtained.

W. R. SHUTE.

Halifax, Nova Scotia, February 4, 1903.

Further Information on Muirhead-Lodge Wireless Telegraphy System.

An interesting attempt to prove the efficacy and practicability of the wireless telegraphic system invented conjointly by Prof. Oliver Lodge and Dr. Muirhead is being made by the Eastern Extension Telegraph Company, of England, which has equipped its two new cable vessels to be dispatched to the southern seas with this apparatus. These two cable steamers, named "Patrol" and "Restorer" respectively, have been specially designed to accomplish the work concerning the up-keep of the enormous stretches of cable laid and to be laid between the continents of Asia and Australia. They will not return to England until they have been absolutely worn out and are unfit for further service, when they will be relegated to the scrap heap. The ships are strongly constructed in view of the exceptional nature of their employment, and their equipment is of the latest and most approved design. Each ship is provided with four huge tanks with a capacity of nearly 28,000 cubic feet, to contain the cable, and very powerful gear is furnished for picking up a broken and damaged line, and for paying out. The ships are replete with numerous instruments for testing purposes, while by an ingenious arrangement the position of a break, although considerably distant from the position of the ship, can be gaged to within fifty yards.

The object of the wireless telegraphic installation is to enable the vessels to exchange communication with cable stations. By means of this equipment it will be able to stop ships on their way home from repairs, and direct them to whatever point they are required, thereby not only saving expense but enabling communications to be re-opened in a shorter time than would be possible if the ships were not provided with this apparatus. It may be mentioned that the Eastern Extension Cable Company already has a permanent wireless telegraphic installation at Porth Curnow, its chief land station in Cornwall. It is proposed that the "Patrol" shall be stationed at Singapore, and the "Restorer" at Adelaide, at which ports the company has depots for the storage of cable. The tanks of both vessels are fully loaded partly with spare cable to be landed at the depots, and also with a cable to be laid for the Netherlands government between Balikpapau, in Dutch Borneo, and the Island of Celebes. The cable is about 650 miles in length.

Proposed Railway in Crete.

The autonomous government of Crete has decided to build a railway of 100 kilometers in length from Candia to the interior provinces on the plains of Messara. The road will serve the purpose of transporting the products of the interior to the port of Candia. Three European engineers have been engaged to make the necessary surveys and topographical drawings. Their work will be completed by the end of March. The road will be built in accordance with the data thus collected. It may be that some American engineer may care to undertake the building of the road. He can obtain the necessary information by addressing the firm of Richard G. Krüger, Candia, Crete.

The Current Supplement.

The leading article of the current SUPPLEMENT, No. 1421, is an illustrated description by H. A. Crafts of the flood reservoir at Fossil Creek. Mr. J. D. Geddes continues his description of photography as applied to illustration and printing. The paper by Messrs, Hutton and Petavel on high temperature electro-chemistry is likewise continued. Fabry and Perot recently communicated to the Académie des Sciences a paper on a source of intense monochromatic light. The paper is translated. Fred. T. Jane presents another installment of the Naval War Game, describing a torpedo action off Key West involving mutual destruction. W. S. Blatchley and W. H. Sheak give an account of Trenton Rock petroleum. The strange animal discovered by Sir Harry Johnston in the heart of Africa, and called by naturalists "Okapi," seems to have been known to Egyptians, if Prof. Wiedemann is to be believed. The Professor has ingeniously compared the living okapi with Egyptian conventional pictures of gods, and has shown that the head of the god Set is a copy of that of the okapi. Prof. Wiedemann's article is published in this SUPPLEMENT. The Consular Notes and Selected Formulæ and Trade Notes and Recipes are also published.

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AMERICAN RAILWAY SLAUGHTERS AND BRITISH RAILWAY SAFETY.

BY FREDERICK MOORE.

On the railways of the United States in a recent three months there happened 1,481 collisions and 877 derailments. In these 51 passengers were killed and 751 injured, 35 mortally. Adding to this list the number of pedestrians run over at crossings—in which America has a specialty—and the employes killed and injured, the figures reach 274 and 2,089 respectively. The record of the United Kingdom averages one-sixth that of the United States, but 1901—a high-figure year in the States—is boasted of in England; not a single passenger was killed.

American has 200,000 miles of railway; the United Kingdom 23,000.

The British roads cost to construct $200,000 per mile, more than three times the investment in America. Sixty per cent of Great Britain's railways are double-tracked, about five times the percentage that exists in the United States. The older country has about fifteen times as much block system, considerably more interlocking switches and signals, and far less of the violent forces of nature with which to contend. Had the high English standard been maintained in America, however, half or three-quarters of the roads could never have been built. Investors have been allowed to build railroads when and where and how they would, and the result is that the United States has a transportation system as extensive as the rest of the world together. The vastness of the country and the thinness of its settlement, compared with Great Britain, make it too expensive to build with English safety.

More than half the roads in America pay little or no dividends, and the payments on the total debt—stock, bonds, floating debts, etc.—are only a trifle over four per cent per annum.

THE WRECK AT LITTLE BYTHAM. THE TRAIN LEFT THE VIADUCT BECAUSE OF THE SPREADING OF THE RAILS.

On the poor lines the freight trains are side-tracked to let the passengers fly by. Interlocking switches and signals are too expensive, and the swing of the switches back to a straight course after the siding has been taken is left to the brakeman of the freight. A freight train will generally slow down while passing—it has no schedule to run on—but when a "double header," heavily loaded, has speed up on a slippery track, the precaution is sometimes dispensed with.

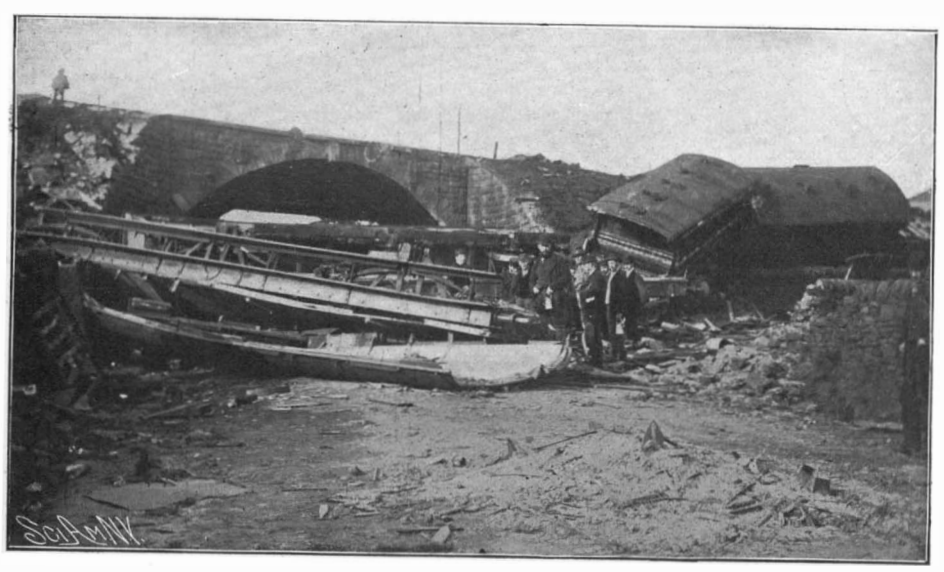
Safety devices and automatic apparatus, as they are adopted, lessen the liability of accidents, but the iron horse can never be taken entirely out of the hands of fallible man. With wet face and sweating body, sitting hour after hour watching, it is a wonder the driver of the steel steed makes as few mistakes as he does. He has often to keep his vigil with open window and with rain or snow or fog driving at him at the rate of a cyclone. Accustomed day after day to seeing his signal the same, he grows careless, mechanically glances at it and dashes on. Just that way at Essendine a freight train on the perfectly equipped Great Northern of England took a siding which ended abruptly. At full speed the train ran up the hill at the side of the roadway until an incline so steep was reached that the engine was hurled back in the mud, turned over on the tracks below.

Accidents due absolutely to man bear exactly the same proportion to the whole—about fifty-five per cent—in both countries. Other than severe fogs, the British trainman has not to contend with the severities of nature which his American contemporary must face. Torrential streams that swell from placid brooks in a night annually carry away hundreds of bridges, and, without warning, weaken the support of others to such an extent that they will no longer hold the weight of a train. In Great Britain there is not the fearful fall of snow in the winter that banks in the "cuts" of the roads of the North, East, and Northwest. Nor does Great Britain suffer from the other extreme, excessive heat. While our temperature, even in the North, runs as high as 100 degrees Fahrenheit, England's seldom reaches 90. More room for expansion of rails has, therefore, to be left in America. The everlasting click as the wheels of a car pass from one rail to another with which we are so familiar is almost unnoticeable in England.

The illustrations will not uphold my statement, but it is a fact that our heavy coaches, weighing sometimes sixty tons, do not go to pieces as readily as the British cars in collisions. Against their strength, however, is the enormous momentum of the heavier trains.

Every division of a railway is equipped with a wrecking train which, for swift movement, beats the work of the fire engine. On a special siding at a convenient divisional point stands a powerful steam crane car, the fire of its engines always ready, its chains, ropes,

TRAIN WRECKED AT ESSENDINE AND COMPLETELY OVERTURNED.



THE WRECK AT LITTLE BYTHAM, SHOWING HOW THE LIGHT ENGLISH CARS CRUMBLE TO PIECES.

A WRECK AT BELFAST. ON A SLIPPERY DAY THE TRAIN WENT THROUGH THE DEPOT.

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and gears in constant, well-greased readiness. In another car of the train are stored jacks of various capacities, from an ordinary affair that may lift a few hundred pounds to one capable of raising thirty or forty tons. On a third car may be found the trucks and wheels to carry any car that may be in need of new ones. Then there is the living car, equipped with berths in which the men may rest on their way home after the wreck is cleared, and containing a cook stove and a constantly supplied larder. The engine and crew? There is generally one of the former with steam up in the yard, but should there not be, the next freight or passenger that comes by is robbed. From the telegraph operator's office to the homes of the wrecking crew—always located near the station—wires run that sound deafening gongs at the touch of a telegraph instrument. Before the brakeman, arriving on foot at the nearest station, can tell the whole of his story, wrecking men are on the way to their train. Orders are ready when they arrive. They are to stop at the next station and pick up a doctor and a telegraph operator. The operator will attach an instrument to the wire immediately upon arriving at the wreck, the doctor and his force will get into action at once, the wreckers will spare no expense in clearing the way. "Economy" and "save" are words not in their vocabularies. Cars are lifted by the huge crane—whose fires have been fanned by the rapid run until the safety valves on the boilers are lifting—and thrown over on their sides clear of the tracks. Cars that cannot be immediately righted are pitched aside until there is time to build a side track and mount them on it. Only heavy washouts on the great rivers or similar catastrophes block the roads for more than a few hours.

A NEW SIGHTING GEAR FOR NAVAL GUNS AND GUNNERY SIGNALING APPARATUS.

BY OUR LONDON CORRESPONDENT.

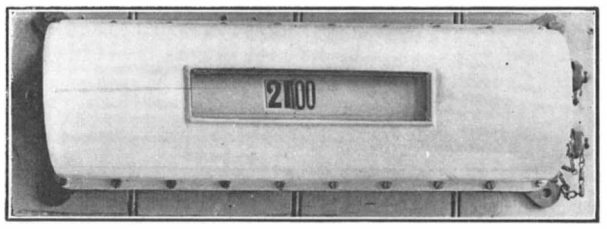
Although by constant gunnery practice and severe drill the training of expert naval gunners is carried to a high standard of efficiency with regard to the handling and firing of naval ordnance under conditions similar to actual warfare, it is an indisputable fact that the success of a naval engagement will, to a very appreciable extent, depend upon the perfection of the mechanism employed to bring the guns to bear upon the antagonist, and the means for rapidly and correctly meeting the ever varying circumstances that will arise.

The fact that naval artillery is fired upon the high seas introduces the most difficult conditions for successful practice conceivable, owing to the motion of the ship due to the action of the waves, and the extreme mobility of the target. Moreover, as the issue of an engagement, other things being equal, will almost certainly be determined by the establishment of a superiority of effective fire during the first few minutes after the commencement of hostilities, it is imperative that the handling of the gun should be rapid and accurate under all conditions.

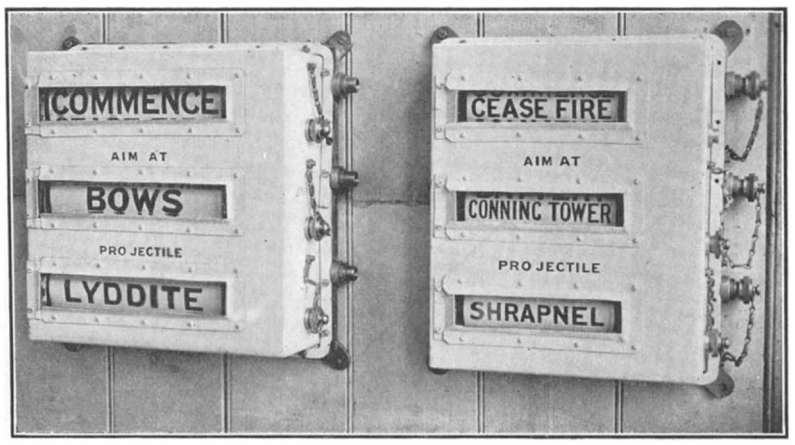
To attempt to overcome the difficulties which from the nature of the case beset the gunner in his duty of laying a naval gun upon a target, it is necessary first to define clearly the separate elements which are comprised in the art of gunnery itself; then to study their relation to the conditions under which the art is practised, and finally to so devise the necessary mechanism that it shall eliminate as far as possible any adverse effects the field of operations may create. Further, means must be provided for the most effective employment of the artillery as a whole, with prompt response to the varying and incalculable conditions of the fight.

The elements of successful gunnery irrespective of the nature of the circumstances under which it is carried out, are that the opponents should be hit frequently, and hit effectively every time.

To achieve this desideratum, two distinct operations are involved; First, that the sights should be accurately aligned upon the opponent and the gun discharged; secondly, that the angle between the axis of the gun and line of sight should be correct for the distance of the opponent. To hit the antagonist with the best advantage demands that he should be struck in the right place, with the correct projectile, and with concentrated effect.



THE SIGNAL APPARATUS INDICATING THE RANGE.



ELECTRICAL INDICATORS FOR ORDERS AND SIGNALS.

In considering these fundamental functions in the light of the conditions and requirements of an engagement at sea, it will be observed that such conditions and requirements necessitate very special adaptations of the operations involved in these functions.

These conditions and requirements may be enumerated as follows:

(1) The gun is mounted upon an unstable platform.

(2) The target is extremely mobile both in position and distance.

(3) It is of the utmost importance to establish the initial superiority of fire.

(4) The varying phases of the fight, each demanding special treatment, must be met with promptness.

(5) The superiority of fire must be maintained under all conditions until the opponent hauls down his flag or goes to the bottom.

Concerning the problem of adapting to the needs of sea work the method and means of carrying out the elementary operations of gunnery, the first process, that of aligning the sight and firing (the duties of the gun captain), is a task of extreme difficulty. Not only is the opponent constantly on the move, but the ship itself is in motion, and these together are combined with and aggravated by the roll of the ship. It may be laid down that the perfection of this operation is to maintain the sight constantly upon the opponent, giving instant readiness to fire and eliminating personal error. To attempt this the gun and sight have to be kept constantly on the move; and this is such a difficult and delicate task, that it requires the whole and concentrated attention of the gun captain, notwithstanding the common practice of assisting him by intrusting one component of the laying (the training) to another gun member.

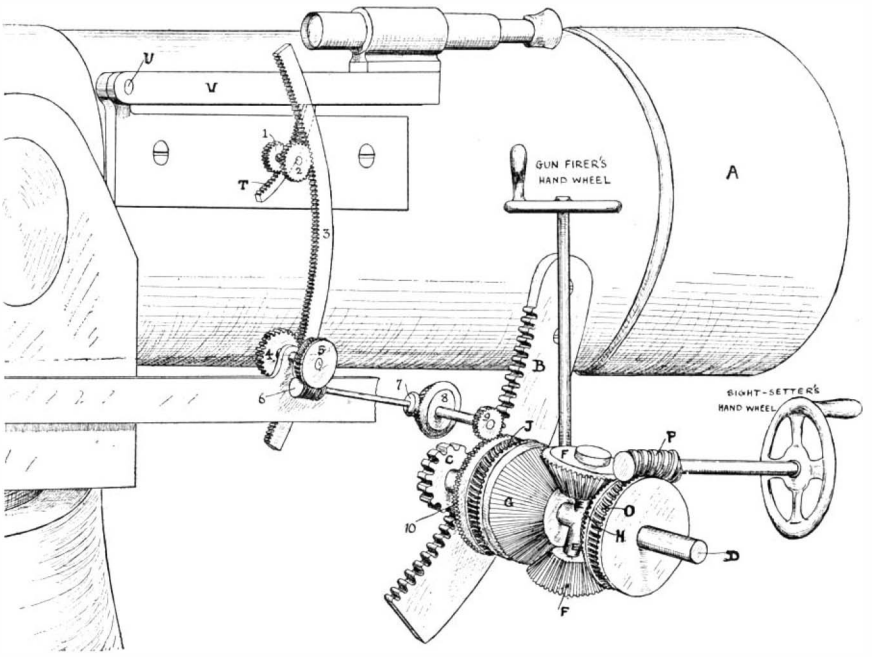
It may be confidently affirmed that the work of these two men must be simplified to the utmost, so that their whole attention may be directed to its performance. This necessitates that the mechanism in their hands must maneuver the gun with speed, and yet be simple and easy to work, and moreover that it involves the performance of that operation completely, and of that operation alone. But what of the adjustment of the angle between the axis of the gun and line of sight for the range of the antagonist? Unless this is correct the work of the gun captain will be nullified. Therefore, since it is clear that he cannot assume this duty himself without detriment to his own peculiar operation, it follows that it must be intrusted to another man, commonly called the sight setter.

The main requirement in this operation is that at the instant of discharge the angle between the axis of the gun and line of sight should be correct for the range of the opponent. The controlling conditions are the continual alterations of the range; the extreme difficulty of determining it with anything approaching to accuracy; and the vital importance of ranging upon the opponent before he ranges upon you, and subsequently maintaining an accurate fire under all conditions of change of range.

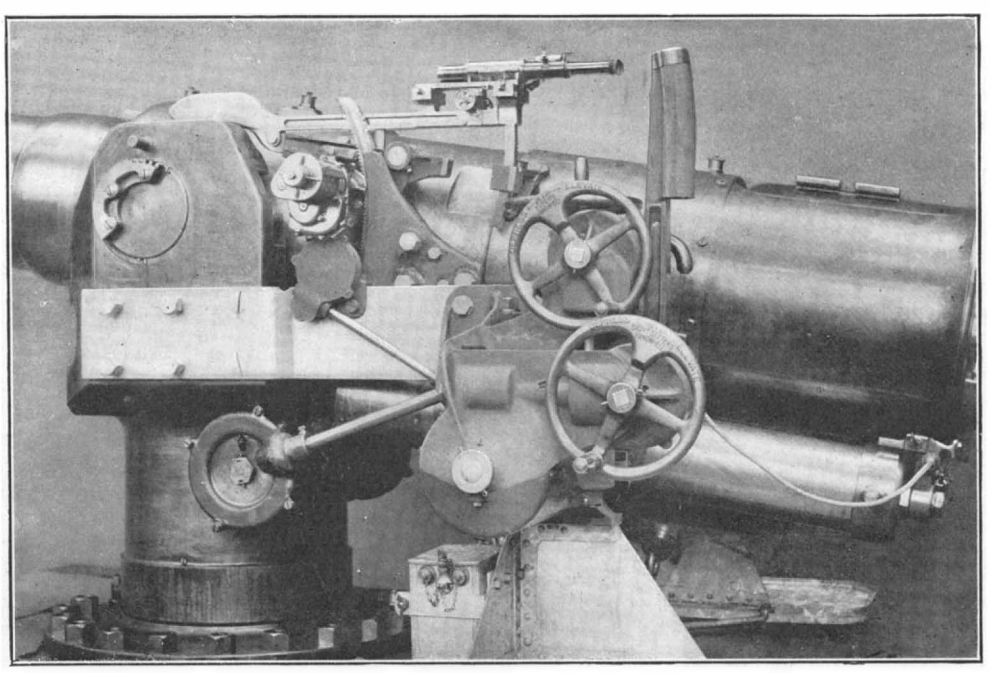
The continual alteration in the range of the opponent necessitates that the angle between the gun and sight should also be continually altering, in order to insure that at any instant the gun may be discharged with the adjustment correct. A combined aggregate closing speed between the two antagonists of 30 knots would not be excessive, and as this would give a decrease in range of 100 yards every six seconds it will be seen that this alteration may be very substantial.

The present method of adjusting the angle is to move the sight with relation to the gun and then to move the gun and sight together to align the latter. It will be observed that the gun captain has to perform the last named operation. The movement of the sight to or from the gun to effect the adjustment must, if the sight is aligned upon the target, necessarily throw the line of sight off the target, and if a telescope is employed it may possibly carry the target out of the field of the telescope altogether—in any case disturbing the aim of the gunner, who has to perform a subsidiary operation to that for counteracting the roll of the ship and movement of the target. Moreover, this disturbance of the line of sight, if effected at the moment of firing will cause either inaccurate shooting, or a delay necessary for a new alignment; and the accompanying uncertainty of the gun captain and consequent distraction of his attention are highly prejudicial to accurate shooting.

With the gear designed by Captain Hubert Grenfell of the British navy, by whose courteous permission we are enabled to publish the accompanying illustrations of the fitting on board the British cruiser



DETAILS OF THE OPERATING MECHANISM.



THE GRENFELL GUN-SIGHTING MECHANISM, SHOWING DIFFERENTIAL GEARS OPERATED BY THE GUN-SETTER.

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"Narcissus," together with a diagrammatic explanation of its action, this delay, inaccuracy and distraction are entirely eliminated. The most salient feature of this device is that when effecting the adjustment of the angle between the gun and sight it is not the sight that moves, and the gun that remains still, as in the existing service mountings, thus disturbing the aim and necessitating a subsequent operation; but the gun is the moving part and the sight remains fixed. The gun is in fact moved toward and from the sight, the angle being shown by a suitable indicator marked in ranges. The consequence is that the line of sight is not disturbed in any way, the speed of adjustment is increased, and the gun captain being unconscious that the operation is taking place is left unaffected by any extraneous influence and consequently is free to devote his whole attention to his own particular duty.

Moreover, the sight setter can maintain the adjustment correct with the utmost confidence and celerity right up to the instant of discharge. He is in fact necessarily raised to his true value, and his function becomes of extreme importance, since it is no less than that of controlling the work of the firer of the gun to produce the desired result.

The operations of both the gun captain and sight setter, although each involving a distinctly different set of relative movements of gun and sight, can be carried out simultaneously as well as independently. This is effected by the introduction of a differential train of wheels into the elevating mechanism, one end of the train being under the control of the gun captain by means of his hand wheel, while the other end is under the control of the sight setter, who is provided with a similar hand wheel. The motion imparted to the gun, if both hand wheels are worked simultaneously, is the sum or difference of motion imparted by the hand wheels, depending upon whether they are worked in the same or opposite directions—but the result, as far as the alignment of the sight and the adjustment for the range are concerned, is the full amount intended by the respective operators, being wholly dependent upon the motion of their hand wheels, and completely under their separate control.

This mechanism, then, fully provides for the requirements imposed by the conditions of continual and rapid change of range, and the imperative necessity of isolating the arduous duties of the gun captain. A more comprehensive explanation of this action of the Grenfell gear is afforded by means of the accompanying diagram, wherein the mechanism of the apparatus is shown. *A* is the gun cradle, *B* is the elevating arc, *C* is the elevating pinion mounted on the shaft *D*, carried by fixed bearings on the mounting. On the shaft *D* is a differential train of wheels comprising a cross-arm *E* fixed to the shaft and carrying a pair of bevel wheels, *FF*, gearing with the driving wheels *G* and *H* mounted loosely on the shaft. Formed on the driving wheel *G* is a worm wheel *J* gearing with a worm *K* (not visible in the diagram) which is driven by a hand wheel under the control of the gun firer for bringing the gun and sight to bear on the object to be fired at *without altering the sight relatively to the gun*. Formed on the wheel *H* is a worm wheel *O* gearing with the worm *P* driven by a hand wheel under the control of the sight setter *for adjusting for range*. The sight bar *V* is pivoted on the cradle *U*, and its curved rack *T* gears with a pinion *I* carried by the cradle (bearings not shown for sake of clearness), and fixed to turn with a pinion 2 which gears with a curved rack 3 mounted with, and capable of sliding in, a curved guide (not shown) fixed to the cradle. The center of curvature of the rack 3 and of its guide, is the center of the trunnions. 4 is another pinion geared to the rack 3 and fixed to rotate with a worm wheel 5 gearing with a worm 6 that is driven through a pair of bevel wheels 7 and 8, and pinion wheel 9, by the tooth wheel 10 formed on the wheel *G* of the differential train.

The action when operated by the gun firer only is as follows: To elevate or depress the gun *without altering the sight bar relatively to the gun*, i. e., to align the sight, the gun firer turns his hand wheel in the required direction, thus turning the driving wheel *G* of the differential gear, which imparts a rotary motion to the radial bevel wheels *FF*. As the opposite wheel *H* is meanwhile held fast by the worm *P*, the driving wheel *G* causes the radial wheels *FF* to roll on the now stationary wheel *H*, thus turning the elevating shaft *D*. The gun is thus elevated or depressed, as the case may be. At the same time the tooth-wheel 10, being fixed to the driving wheel *G*, is turned, thus elevating or depressing the curved rack 3 *with the gun*. There is therefore no relative motion between the rack 3 and the pinion 2, consequently the general result is that the "*axis of the gun*" and the "*line of sight*" are raised or lowered through the same angle without altering the adjustment of the sight bar for range.

The action when operated by the sight setter only: *To alter the adjustment of the sight* for an increase or decrease of range, the *sight setter* turns his hand wheel in the required direction, thus moving the driving wheel *H* and imparting a corresponding motion to the elevating pinion *C*; the radial wheels *FF* in this case rolling on the driving wheel *G*. The latter being held stationary by its worm, no motion is given to the curved rack 3, which remains locked, its guide moving with the cradle. The pinion 2 also moves with the cradle and consequently rolls on the stationary rack 3, thereby turning the sight bar relatively to the gun cradle through the same angle as that through which the cradle moves, but in the *opposite direction*. The result is, therefore, that the "*line of sight*" does not move, but the "*axis of the gun*" under the movement of elevation or depression given to the gun by the rotation of *C*, moves up toward or down from the "line of sight," according to the direction and extent of the change in range.

The action when operated by both men together is that both wheels are worked simultaneously. The speed of both operations is therefore entirely dependent on the speed with which the wheels are turned, and the motion of the gun, as already stated, is the sum or difference of the motions imparted by the separate gears. The result in this case is precisely the same as that which would be produced if the operations were performed separately and in succession.

With mountings, however, in which the sight pivots round the trunnion axis, the intermediate gearing numbered in the sketch, is not required.

With regard to the ranging of the gun this may be achieved in various ways—by estimation; by the use of range finding instruments; by the observation of fall of shot, etc. But it is believed that the last named method is the only one that will give the required accuracy, speed, and continuity under the extremely adverse conditions of a naval engagement.

In order that the sight setter may obtain the proper data for the performance of his duties, he must be either in a position to observe for himself, not only the opposing ship and the varying conditions, but also the fall of the shot from his own particular gun.

But where two ships are hotly engaged and all guns are being fired with the utmost rapidity this will be practically impossible. Moreover, the modern practice of mounting guns in casements and in inclosed batteries does not allow of the extended view that is requisite; nor under the circumstances is the sight setter in a position for calm observation and rapid deduction.

On the other hand, if all guns are adjusted for the same range, etc., their shots would fall in close proximity to each other, and an independent observer from a satisfactory position would be able to determine the amount of correction necessary, first with the target, and subsequently to maintain effective fire.

This is the idea embodied in the system of range indicators, also devised by Captain Grenfell, herewith illustrated. The apparatus is based on the well known bracket system of ranging, and the following is a description of an installation lately fitted in the British battleship "Venerable." Close to each gun in the various groups is a range indicator, showing ranges from 1,000 to 10,000 yards. The indicators of each group of guns are actuated by a transmitter in the conning tower, whereby an operator in the last named part of the ship orders the same adjustments for all the guns.

In the fore-top is an observer whose duty is to note and inform the conning tower as to the position of the fall of the shots with relation to the target. For this purpose he is provided with a transmitter actuating a similar recorder in the conning tower showing this relative position of the shot to the target, either short or over. Upon this data the operator in the conning tower corrects and maintains the range ordered for use by the guns. Thus the sight setters are kept constantly supplied with the precise information upon which the effect of the fire depends, and a very high collective accuracy of the artillery fire is assured.

There now remain the final conditions that must be satisfied, namely, providing means to insure that the artillery is employed in the most suitable and effective manner in each of the varying phases of an engagement, and the prompt handling of exceptional and fleeting opportunities, giving in effect the captain of the ship the immediate control over all the elements in the offensive operations, so that his vessel as a whole shall respond instantly at his command to the exigencies of the moment.

For this purpose Captain Grenfell has devised a system of electrical indicators (of which the beforementioned range indicators form one part) showing the necessary orders and signals. This system has been installed in the battleship "Venerable," and in the accompanying engraving we illustrate some of the instruments.

The system embodies the following features which are essential to any practical system: (1) Ability to give *immediate* orders to *all* parts of the ship whose combined actions are the groundwork of rapid and accurate firing. For example, while all guns must be kept acquainted with the range, the nature of the fire to be employed, the antagonist and at which part of her to aim, it is not less necessary that the shell rooms and supply parties should know immediately (as the guns) what they are to supply and any change in their duties. (2) That the orders when displayed in the various parts of the ship should be very legible, and that to prevent mistakes, only one order should be seen at one time, namely, that which has to be acted upon. (3) That an order once displayed should remain visible and acted upon until countermanded by another order.

Confusion is inevitable unless these principles are carried out in the system employed.

In the Grenfell system the orders and signals are displayed upon the surfaces of drums. Each group or nature of orders is arranged upon a separate drum. Only one order of each group is rendered visible at a time, the drum being rotated so as to bring the required orders opposite an aperture in the covers of the instruments.

For the purpose of the system the various groups of guns, their shell rooms and supply parties, are taken as separate units, and all the indicators of each unit are operated by a single set of transmitters in the conning tower. By this means each group of guns can be handled separately, and the chance of a general breakdown is minimized.

The conning tower transmitters are mechanically operated while electrically actuating the receivers at the guns, etc. In this way the transmitters are very considerably reduced in size and occupy little area in the confined space of the conning tower. Moreover, it has been found possible to make them very much more substantial than electrical instruments, which as they will be exposed to the concussion of bursting shells either on, or in proximity to, the conning tower, is very desirable.

The arrangement of the indicators in a group of 6-inch guns is as follows: At each gun are instruments showing the range, the bearing, the particular ship of an enemy's squadron, the part of the opponent it is desired that that particular gun should attack, the projectile to be employed, the orders to commence slow or rapid fire, and to commence and cease fire.

In each shell room, and at each supply tube or whip is an indicator showing the nature of the projectiles to be supplied. The change of an order at any position is announced by the ringing of a gong. A similar arrangement is employed for the main armament, the range and bearing instruments, etc., being suitably placed for observation from the sighting hoods.

From this it will be realized that the captain of the ship can immediately concentrate all his fire upon any particular unit of an enemy's squadron, on any part or parts of that ship, and with the projectile most suitable to the range and the nature of the resistance offered. He can change the nature of the projectile as occasion demands with the greatest celerity, and no confusion can take place below. He can direct one group of guns to attack one part, and another group of guns to attack another part of his antagonist. In fact, with this system he can handle his ship and all the armament as a single weapon, over which he has absolute and instant control.

Brief Notes Concerning Patents.

Oscar Hammerstein, the theatrical manager, is the inventor of no less than eighty devices of various kinds on which he holds patents. His latest achievement is a machine for wrapping cigars. The thin wrapper is picked up and held against a wooden block by means of an air suction, and is passed over and around a bunch of tobacco, which it proceeds to encircle from one end to the other. Mr. Hammerstein says that at a cost of $1.50 per thousand, this machine will do the work of a man who is now getting $4.50 per thousand, and will do the work generally better.

By the invention of J. D. Kneedler, of Sioux City, Iowa, a vending machine has been made which will give up a spool of thread, cotton or silk, upon being fed a coin. As the machine gives the operator the choice of a large range of color and size, it has met with the favor of several manufacturers in the silk and cotton business, and the machines will be placed in a large number of stores throughout the country. They are said to be favored also by the store proprietors, for the reason the scheme prevents theft and relieves the salesmen of the annoyance of attending to trivial sales.

Ex-Senator Charles A. Towne, of Minnesota, recently paid a visit to Niagara Falls, for the purpose of making preliminary arrangements for the construction of a new building to accommodate a new industry. The Senator is interested in the American Carbolite Company, and it is proposed to locate a plant there for the manufacture of an acetylene gas generator and other allied industries. The works will cover about ten acres, and will give employment to about three hundred men. It is proposed to build a model city, which will be brilliantly illuminated by the use of acetylene. The process made use of by the company is the invention of Herman L. Hartenstein, of Chicago.

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Legal Notes.

SUBSTITUTION OF MATERIALS.—A suit in equity was brought by the National Tooth Crown Company against Macdonald (170 Fed. Rep., 617), for an infringement of the White patent for a mold for shaping metallic tooth-crowns. The defendant set up prior letters patent granted to J. C. Parker for an improved swage for dental plates, as an anticipation of the White patent. The complainant's invention was designed for the manufacture of metallic tooth-crowns formed of a single piece of metal, without soldered seams, and completely conforming to the contour of the natural tooth.

A cast is first taken of the tooth to which the crown is to be applied, and from it a metallic die is made. A disk of gold is then shaped into a cap or cup, by means common in the art, fitted to the metallic die, and manipulated by mild hammering to reduce and round the edges of its grinding surface. At this point the mold contained in the complainant's device enters into use. He provides a casing containing a soft metal core or mold, with a hole for the reception of the metallic die and its gold covering. By pressure the die is forced into the soft metal, and the soft metal itself, acting in accordance with the laws governing fluids under pressure, forces or swages the sides of the thin gold or other metallic cap into conformity with the inner metallic die. In the alleged anticipatory device, a mold is made from the initial impression of the plaster cast, a thin plate of aluminium, gold, or other ductile material is roughly formed around the mold, and the mold then placed within a cup-shaped casing. A quantity of granular, shot-like material is then placed around the mold, filling the space between the mold and the casing. Vertical pressure is brought to bear upon the shot-like material. By reason of the curved surface of the casing, and the conversion of the shot into a solidified mass under pressure, the pressure upon the mold is practically equal in all directions, and the thin metal plate is thus made to conform to the contour of the mold.

The same law of operation is undoubtedly involved in these devices. In the Parker patent it is stated that the object is to obtain a pressure that will be practically equal, without the use of water or other liquid. For this purpose, shot-like material is used as an adjustable medium. In the complainant's device a soft, solid material was used in the place of the shot. The idea of each device was to produce a perfectly formed or contoured covering upon a certain shaped die—in the Parker patent a dental plate, and in the complainant's patent a tooth-crown—without seaming or soldering. In each case a receptacle approximating to the form of the die was used, and the intervening space filled with a material that, under vertical pressure, gave lateral pressure upon the die, thus swaging the metallic covering to the perfect contour of the die.

It was urged that the complainant's device differed from that of Parker in that the character of the article intended to be formed—namely, the tooth-crown—is of a wholly different shape from the dental plate; that instead of a comparatively flat curved plate, which may be formed by means of force acting in a vertical direction, the object was to compress laterally a cup or sack-like shell around a die. Also, that the variation in form of the interior of the casing of the complainant's device, and the providing of an aperture in the casing for the escape of superfluous metal, constituted such an improvement in the art as to involve invention. In the opinion of the court these variations from the earlier patent were merely such a carrying forward of the original idea as would naturally present itself to the mind of any skilled metal worker. "Something more is required to support a patent than a slight advance over what has preceded it, or merely superiority in workmanship or finish." (International Tooth Crown Co. v. Gaylord, 140 U. S., 55, 62; 11 Sup. Ct, 716; 35 L. Ed., 347.) Substitution of materials in the production of an article is not invention, unless such substitution involves a new mode of construction, or develops new uses and properties of the article made; or, where the superiority of the substituted article is shown to consist not only in greater cheapness and greater durability, but also in more efficient action. Such a showing was not made in this case. A decree was entered for the defendant.

AN ELECTRIC CONVERTER DECISION.—Suits for infringement of letters patent issued to George Westinghouse, Jr., and to Elihu Thomson, for cooling transformers, were brought by Westinghouse Electric and Manufacturing Company and the Thomson-Houston Electric Company against Union Carbide Company, (117 Fed. Rep. 495). Decrees were given for the complainants in the Circuit Court. An appeal was taken, and the decree affirmed as to the Westinghouse patent, and reversed as to the Thomson patent.

Claim 4, of the Westinghouse patent, covers an electric converter constructed with open spaces in its core and an inclosing case containing oil or paraffin, adapted to circulate through the spaces and about the converter for the purpose of cooling the converter. The defendant tried to show that this scheme was anticipated by the Stanley patent of 1886 for an induction-coil, which patent is for a converter, the spaces on the core being so stamped as to form interior and exterior teeth. The description and drawing of the Stanley patent show a base plate and perforated cover adapted to ventilate the cover and to protect it from physical injury. Hence the prior art shows every element of the combination claimed, and a physical combination of the same elements except that the separation in the Stanley invention and the construction of the inclosing case was prohibitive of the purposes of the claim in suit. This claim covers such an inclosing case as will confine the non-conducting fluid, and such open spaces in the core as will permit the circulation of the liquid through them. The Court held that Westinghouse was the first to patent such an air-tight converter. For the prior design excluded the novel idea of circulating oil through the tube and intervening spaces of the coils and plates. In the Court's opinion the patentee was entitled to his claim. As we have remarked, the Circuit Court of Appeals affirmed the decision.

The Thomson patent is for cooling transformers, designed to preserve the transformer practically cool by exposing oil or other insulating fluid in which the transformer is immersed to some special artificial cooling medium, which may be passed through the oil or through which the oil may be circulated. The Thomson-Houston Company claimed that Thomson was the first to cool oil in the Westinghouse converter, by exposing it to a pipe of running water. The Court held that he was not, in view of a British patent granted to Pyke and Barnett in 1890, on which all the claims of his original application were rejected.

These inventors say in their specification:

"It is obvious that the external substances into which the heat is finally dissipated may be air, water, etc., and that the cooling vessel may be internal or external to the apparatus container."

It was held that the Thomson invention was simply the use of an old device for a new and analogous purpose, without the necessity of any adaptation in order to discharge the old function in the new device. Its confessed commercial success could not, therefore, be accepted as evidence of invention.

AN IMPORTANT TRADE MARK DECISION.—The Lion Fig and Date Company, of Chicago, Ill., last November filed an application for the registration of a label with the Commissioner of Patents. A refusal to register the label resulted in an appeal to the Commissioner. The subject of the label was described as follows:

"The word 'Brittlenut' printed in red ink in diagonal script, the first letter of which word extends from nearly top to bottom of the label. In the upper curve of said letter is placed a lion's head. Below the word Brittlenut and also printed in red ink in three lines are the words 'The Lion Fig and Date Company, Chicago, Ill.' The entire label is printed in red ink on yellow glazed paper."

The Examiner held that the word "Brittlenut" is an arbitrary and fanciful word, and that the label was believed to be artistic. According to the Patent Office rules, a label must describe the product to which it is to be applied. Finding that the word "Brittlenut" is composed of two words, and that the compound word probably means that the confection contains some kind of a nut and is brittle in character, nevertheless he does not think that the word in any way describes a confection composed of sugar, syrup, and peanuts. The Commissioner in sustaining the Examiner said that, although the two words "brittle" and "nut" had well-known meanings when used alone, yet when used together they could not be said to describe the confection made by the applicant. Indeed, he even went so far as to declare the combination of the two words indicated no confection at all.

In previous cases it has been held that the word "label" itself necessarily implies that it is descriptive of the article to which it is applied, and that this must be indicated in the print or label itself, and not merely in a statement made by the application accompanying it.

KIPLING'S "TRADE MARK" SUIT.—For the second time Rudyard Kipling has lost his action against G. P. Putnam's Sons for infringement of copyright and trade mark and unfair competition. In 1899 the Putnams bought from Kipling's authorized publishers a number of unbound sheets of Kipling's writings and bound them up, together with some of his uncopyrighted writings, to form a Brushwood edition. On fifteen sets there was imprinted an elephant's head, inclosed in a circle. This, Kipling alleged, was his exclusive literary trade mark. The court held that the Putnams had a perfect right to purchase unbound leaves of Kipling's copyrighted works and to resell them in bindings of their own. Judge Lacombe in the following terms flouted Kipling's contention that the Putnams appropriated his trade mark:

"The proposition that an author can protect his writings by a trade mark is unique and, at first blush, seems somewhat startling. It is certainly offensive to the æsthetic and poetic taste to place such poems as the 'Recessional' and 'The Last Chanty' in the same category with pills and soap, to be dealt in as so much merchandise. We do not intend to decide that such a trade mark is sanctioned by the law, but even if it were, it is manifest that the mark does not lose its characteristics because used to designate an unusual variety of 'goods.' In other words, the author, assuming that he may have such protection, must comply with the law if he would have a valid trade mark."

AN IMPORTANT COPPER PATENT DECISION.—In the United States Circuit Court, January 31, 1903, Judge Knowles decided that the Manhes process of converting copper ore into commercial copper was not new; that it was merely the Bessemer process of converting iron into steel as applied to copper, and that for that reason the owners of the patent were entitled to no damages from the Boston and Montana Mining Company for alleged infringement of the patent. Before the legal opinion has been published it is impossible for us to say on exactly what grounds the Court held the patent invalid. This much is, however, certain, the mere fact that the Bessemer process had been applied to copper refining is hardly a good ground for declaring a patent invalid, unless, indeed, the original Bessemer patent claims covered the refining of all metals by means of the converter. How important the decision is may be gathered from the fact that almost all the copper mined in the United States is converted by the Manhes process. Had the complainants maintained their action, damages amounting to many thousand dollars would have been awarded. It remains to be seen what the Court of Appeals will decide.

A law still obtains in France, under which any workman who divulges information regarding a secret process practised in any industry, to a foreigner, or even to a Frenchman resident abroad, commits a penal offense, and for such is liable to a sentence ranging from two to five years' imprisonment and a fine from $100 to $4,000. He is furthermore subjected to from five to ten years' police supervision after his release from jail. Even the communication of such information to another Frenchman resident in France in punishable, though the sentence in this case is not so severe, the sentence varying from three months' to five years' imprisonment, accompanied by a fine ranging from three to forty dollars. On the other hand, a French employer is entitled, without reserve, to any invention or discovery made by a workman in his employ that is within the scope of the work undertaken at the factory.

CONSTRUCTION OF CONTRACTS OF ASSIGNMENT.—In the case of the Goodyear Shoe Machinery Company against Dancel (119 Fed. Rep. 692), it appeared that the assignee of a patent contracted to pay to the assignor in each year while the patent "remains in force as a valid patent, the sum of $5,000 as an annuity." The court held that such payments do not cease on the death of the assignor simply because they are termed annuities, and that payment may be forced by the legal representatives so long as the patent remains in force. Furthermore, it was held that because the assignee of the contract assumed the obligations of his assignor, he did not become a party to the contract, so that he could be sued thereon at law by the other party, nor could such an action be maintained on the doctrine of subrogation, which pertains to equity alone.

LIMITATION AS TO PROCESS.—A claim of a patent for a new chemical product, which is described with such clear marks of identification that it can be readily recognized aside from the process by which it is made, is not limited to the product of a particular process because such a process is described in the specification and is the only process by which it can be produced.

A patent specification is addressed not to lawyers, but to those skilled in the art to which the subject-matter appertains. It matters not how many other people fail to comprehend the meaning of the patent so long as the craftsman familiar with the art can understand it.

A mechanical equivalent must be capable of use as a substitute for something else, and competent to perform the functions of a particular device for which it may be substituted.

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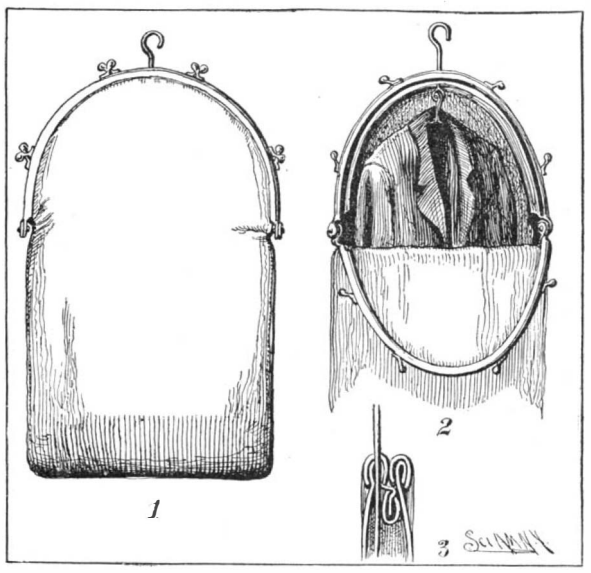
Patent Department

SELF-SEALING MOTH BAG

The odor of moth balls and other substances designed to keep moths from woolen garments when stored away for the summer, is quite as offensive to some people as it is to the moths themselves. Consequently, when in the fall these garments are taken out of storage they must be thoroughly aired for a considerable period before they will be sufficiently deodorized to be worn. All this disagreeable odor and the work it involves may be avoided by the use of a moth bag such

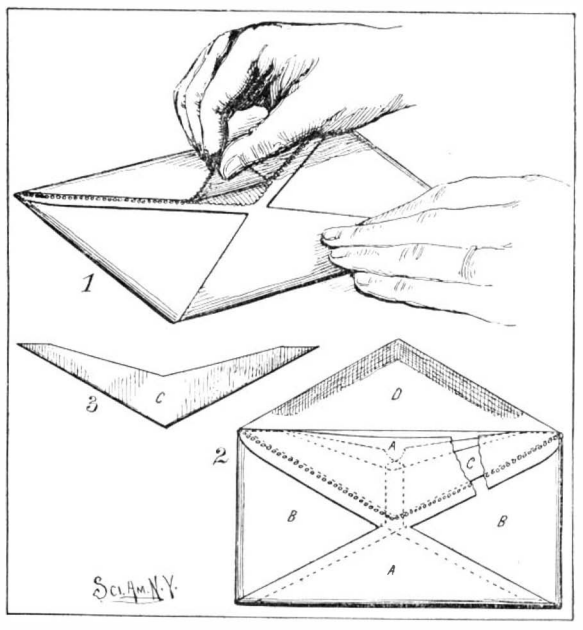


SELF-SEALING MOTH BAG.

as that invented by Sophia L. McMillan, of Winnipeg, Manitoba, Canada. Our illustrations show the form of this bag. It is made of rubber or oilcloth, so as to be water-proof and dust-proof, as well as moth-proof. The mouth of the bag is provided with jaws consisting of metal strips folded upon and engaging the material of the bag as shown in the sectional view 3. Suitable fastening devices are provided for locking the jaws together. A guard strip embraces the edge of the material depending from one of the jaw members, so that when the jaws are closed this strip will press against the jaw member on the opposite side and effectually prevent the entrance of moths, dust or the like. Suspended within the bag is a hanger upon which clothing may be hung. The hanger is attached to a rod passing through one of the jaw members and terminating in a hook for engaging a nail or other device when it is desired to suspend the bag, thus placing it out of the reach of mice or rats.

SAFETY ENVELOP.

It has occurred to Mr. M. L. Hinchman, of 175 Grove Street, Rutland, Vt., that the best way to detect the unauthorized opening of letters is to provide a line of perforations just along the edge of the sealed flap,



SAFETY ENVELOP.

so that any attempt to pry open the flap will result in a mutilation of the envelop, and any attempt to steam open the flap will be detected by the spreading of grease along these perforations from a waxed or paraffined strip of cardboard concealed in the envelop. The envelop blank is similar to the ordinary envelop with the exception that the bottom flap is provided with an additional section containing the perforations above referred to. This flap is marked *A* in Fig. 2 of our illustrations. In forming the envelop the side flaps *B* are first folded over and the waxed piece *C* placed in the position shown, then the flap *A* is folded over and sealed along its edges to hold the parts in place. Thus are formed the finished envelops. When used, after the letter has been inserted and the flap *D* folded down and sealed, it is evident that no edge except that of flap *A* is available for steaming or prying open, and this, as we have shown, is impossible without detection. These safeguards, however, offer no hindrance to opening of the envelop by an authorized person. Since the lower edge of the stiff strip *C* follows the line of perforation, it is simply necessary to bend the envelop backward, when the point of the strip will break through the perforations, and, by grasping this point between the thumb and forefinger, the envelop can be readily torn open as illustrated in Fig. 1. If it be not practicable to bend the envelop backward, the envelop may be readily opened by passing the thumb nail along the edge of strip *C*, thus breaking through the perforations.

STUDENT'S CHAIR.

The habit, particularly prevalent among students, of stooping over a desk may be largely cured by the use of a chair such as is shown in the accompanying illustrations. This chair, it will be observed, is so arranged that the occupant may sit erect while studying from his textbook, for the latter is placed conveniently before him on an adjustable bookrest. With such a chair there is no excuse for the bent-up and cramped position, which is due largely to improper regulation of the height of one's desk. Mr. Adolph M. Smitz, of West De Pere, Wis., is the inventor of this improved student's chair.

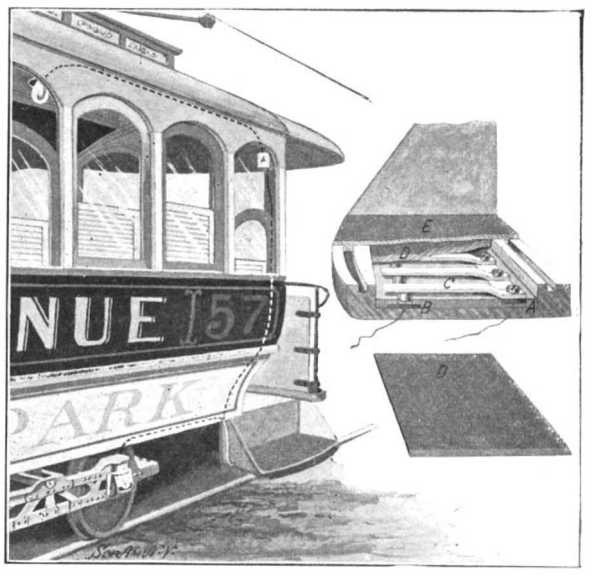
A proper comprehension of the advantages offered by this invention may be had by an examination of its principal details. The bookrest is supported on a rod connecting two posts mounted on blocks, which slide in channels formed in the chair arms. Each post consists of two sections, the lower section being threaded into a sleeve mounted to turn on the upper section. By turning the sleeve the desired vertical adjustment of the bookrest may be obtained; at the same time it may be moved along the chair arm toward or away from the reader, as required. The bookrest may be tilted to any angle, and secured by a thumbnut conveniently located thereon. When it is not desired to use the bookrest, it can be stowed away behind the upper panel of the chair back. This panel, which is hinged at its lower edge, may be swung down to permit passage of the bookrest, when it can be again swung into position, hiding the bookrest from view. One of our illustrations shows a rear view of the chair, with the bookrest in this nested position. Aside from the advantages offered by the adjustable bookrest, the chair embodies additional features which will be found useful to all students. At one side is a bookcase, the cover of which, when raised, lies flush with the right arm of the chair and makes a wide shelf on which books or writing materials may be placed. On the left side of the chair, but not shown in our illustration, is a matchbox and an ash receiver, which may be swung under the chair arm when not in use. Altogether, the chair will recommend itself as a very useful essential to the comfort of all students and book lovers.

A valuable invention, for use in the manufacture of gloves, hoisery, etc., has just been entered at the German Patent Office. The novelty consists in using metal in place of wooden forms. The metal forms are hollow, and, when connected with a steam-heating or electrical apparatus, can be used for giving the article (glove, stocking, etc.) the proper shape. The old cumbersome stoves and furnaces hitherto used for pressing and shaping in German factories will be superseded. Time, fuel and labor will be saved. By means of the new method the articles receive a better finish, more firmness of shape, which is of great value in cotton and silk textures. The heating can be kept at a more even temperature, so that the product is more uniform.

Prof. Weston Melville Fuller, the United States weather observer at Knoxville, Tenn., is the inventor of a fluviograph, by which the stage of the water is automatically registered at intervals, instead of having to go out and make the observation personally, as he has been compelled to do heretofore. A long cable extends over a drum, and at one end of the cable is a float and at the other end a counterbalancing weight. As the water rises and falls, the position of the float is changed, and the movement of the drum operates a circuit breaker, by which means a record is made of the water level at the observation station, which is some distance away from the water's edge. The Professor says that he will not patent his device, but will allow it to be made free use of where desired.

SAFETY CAR STEP.

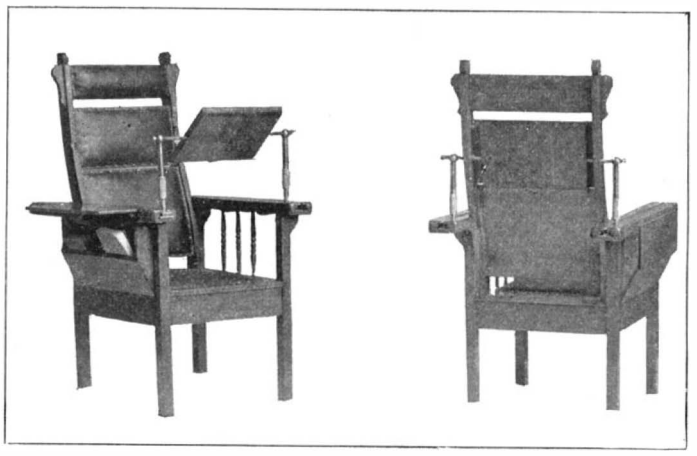
Many street car accidents—and it is surprising that there are not more—are due to the fact that the conductor when collecting fares in the center of a crowded car is unable to see the car step, and is liable to prematurely give the starting signal while a passenger is alighting from or mounting the step. Heretofore



SAFETY CAR STEP.

the conductor has had to depend upon guesswork or the signals of some thoughtful passenger at the rear of the car, but now an efficient method of preventing such accidents is furnished by the invention of Mr. D. N. Jordan, care of J. P. Beagan, 49 Westminster Street, Providence, R. I. The idea of the invention is to provide an incandescent lamp in the center of the car ceiling, which will be illuminated as long as any one is standing on the lowermost car step. This lamp, which is covered by a red globe, would serve as a signal to the conductor, warning him not to pull the bell rope while the globe is illuminated.

The details of the invention are shown in the accompanying illustration. The signal lamp is connected with a circuit of its own, shunted off from the main circuit, and is independent of the lamps which are provided for illuminating the car. The signal circuit, which connects with the ground, is normally broken at the lowermost step of the car. The step is provided with two brass strips *A* and *B*, the strip *A* being electrically connected to the lamp, and the strip *B* having connection with the journal boxes of the car wheels. These strips, it will be observed, are insulated from each other by a wooden board, the strip *A* being imbedded in the upper surface of the board at one end, and the strip *B* in the lower surface at the opposite end. A number of metallic spring arms *C* are secured at one



CHAIR FOR THE USE OF STUDENTS.

end to the strip *A*, and at the other end are provided with contact blocks, which are adapted to project through openings in the board and make contact with the strip *B* when depressed by the weight of a passenger on the step. A sheet of rubber *D* covers the spring arms, and over this is a mat or tread *E* of yielding material, which constitutes the upper surface of the car step. This tread is provided with ribs along its edges, which are adapted to fit into grooves in the body of the car step, thus protecting the interior operative parts of the device from rain, snow, and moisture. Now, when a person is leaving or entering the car, the conductor will know immediately when he has safely mounted or alighted, because the signal lamp will glow when its circuit to the ground is completed by the weight of the passenger on the lowest step, and the red light will continue to shine until the passenger has safely cleared this step.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HEADER-PLATFORM.—R. L. CAMPBELL, SR., G. W. SCHWARTZ, and C. H. SCHWARTZ, Grass Valley, Ore. This header-platform, which is simple and durable in construction, is arranged to comfortably support the header driver or manipulator, and render his work easier and more accurate than heretofore possible under the jolting motion of the header-wheel going over rough ground.

FERTILIZER-FEEDER.—A. L. MINER and S. T. WEST, Kankakee, Ill. This contrivance belongs to the force-feeder class. It is a cheap and substantial device that may be placed on any planter in common use at a nominal cost, and one that will obviate the difficulties experienced in operating planters with fertilizing attachments.

Engineering Improvements.

SAFETY AIR-LOCK.—W. I. AIMS, New York, N. Y. The object of Mr. Aims is to provide an air-lock arranged to prevent occurrence of "caisson disease" among the workmen in subaqueous engineering construction by mechanically regulating the reducing of the air-pressure in the air-lock and while reducing, furnishing to the lock a constant supply of pure warm dry air at the pressure in the lock itself.

VALVE-GEAR FOR ENGINES.—A. D. BAKER, Swanton, Ohio. This invention provides a variable cut-off mechanism so arranged that all wearing parts are adjusted to take up lost motion and they work on a center line relative to each other, thereby obviating side strains and wear. It overcomes crank irregularity and causes the valve to cut off at the same distance from either end of the cylinder, whether the piston moves forward or backward, and also maintains the same lead to early and late points of cut-off.

STEAM-STOKER.—E. B. VALENTINE, Oneonta, N. Y. Among the many advantages of this stoker which admits of general use and is peculiarly adapted for service upon locomotives, may be mentioned, the thorough combustion of coal, the minimum of labor in handling coal, the accuracy with which it can be fed to different parts of the fire-box, and the uniformity with which this fuel may be supplied.

COMBINED EXHAUST-VALVE AND IGNITER.—J. TRACY, New York, N. Y. The inventor has made an improvement in combined exhaust-valves and igniters for combustion engines, and his object is to furnish an exhaust-valve with a simple, inexpensive, and reliable means for igniting the charge of combustion agent, after the engine has been in operation a very short time.

ROTARY-ENGINE.—H. BERGMANN, Berlin, Germany. The counter-roll in this engine has two parts movable with respect to each other, and so arranged that these parts under the influence of screw-shaped surfaces are forced apart, and thus tightly pressed against the inner walls of the side parts of the piston body. A most advantageous and simple packing of the chamber is the result. Furthermore, a decrease of the wear of the working parts is secured, so that the machine is suitable for the highest number of revolutions, with little friction and less of steam.

Lighting and Heating Apparatus.

GENERATING OIL-BURNER. — P. S. SPILLER, Austin, Texas. This oil-burner is designed for use within a stove or furnace for heating purposes. The pipe may be connected with the coupling, and the gas generated be conducted to a gasometer and thence to a system of pipes, for illuminating or other needs, it being intended to thus utilize surplus gas generated in the use of the burner. This burner belongs to that class using heavy petroleum commonly found in Texas.

SAFETY GAS-BURNER.—J. B. LOUGHEAD, Elizabeth, N. J. The invention provides a safety gas burner which is arranged to allow convenient turning on and off of the gas in the usual manner, and to automatically turn off the gas in case the flame is accidentally extinguished.

SMOKE-CONSUMING FURNACE.—J. B. HARRIS, Nashville, Tenn. Furnaces for use on boilers, stoves, open fire-grates, kitchen stoves and ranges, by this invention are provided with a smoke-consuming furnace, very effective in operation, and arranged to utilize the units of heat in the fuel to insure complete combustion.

Hardware.

CONVERTIBLE PIPE AND BOLT WRENCH AND CUTTER.—J. J. GUNTHER, Boston, Mass. Comprised in this implement is a wrench of the pivoted-jaw and cutter type with novel features that adapt it for very effective service as a pipe and bolt wrench or a tool for cutting off cylindrical pipes or bolts. The wrench has a considerable range of adjustment between its jaws.

BRACE.—S. CLAWSON, Salt Lake City, Utah. Owing to the near impossibility of getting an ordinary brace and bit into working position between close joists, the inventor to overcome the difficulty here provides an extensible brace, which will hold itself between the joists so that with or without the help of a pawl-and-ratchet the brace may drive the bit through the joists.

NUT-LOCK.—W. R. YOUNG and G. W. YOUNG, Stockton, Cal. This nut-lock is of that class in which a pawl is connected with the nut and works on a ratchet fastened stationary with respect to the bolt. The device involves novel features of construction, which include an advantageous combination of bolt, ratchet-plate, pawl-collar, a nut, a spring bearing and other parts.

NEEDLE-AWL.—B. E. HERVEY, Ritzville, Wash. This needle-awl consists of a detachable handle portion with a socket for receiving the needle portion when forcing the latter through the material, and one or more hooks combined with a needle having an elongated eye which receives the thread and gives a hold for the hook of the handle for pulling the needle through the material after having been started through by a thrust of the handle socket.

Mechanical Devices.

MILL FOR GRINDING.—J. C. WEGERIF, Battlesbridge, Essex, England. This improvement relates to pan-and-roller mills. The crushing action due to the mere weight of the roll is supplemented in this grinder by a powerful tearing action, whereby the efficiency is greatly increased. By positive driving and the relative arrangement of the roll and pan in addition to the usual crushing stress the particles are subjected to a tensile stress, tending to tear particles asunder, the tearing action coacting with crushing action to produce the disruption.

TRANSMISSION MECHANISM.—A. E. OSBORN, New York, N. Y. Means for transmitting motion at different speeds and directions are supplied by this mechanism. It comprises a gearing especially adapted for use on motor-vehicles, although it may be used for other purposes. The gearing provides a braking means for the vehicle, as well as means for driving it ahead and backward at various speeds.

APPARATUS FOR TREATING ROCK-ASPHALT.—J. S. DOWNARD and B. J. ROLOSON, Lima, Ohio. This apparatus provides means for separating asphalt from the natural rock. It comprises a tank with steam pipes in its bottom and a conveyor for carrying off the "sand" or residue. The crushed rock is fed into the tank at the sides and at the top of the tank between the feeding devices. A skimmer skims the separated asphalt as it rises to the surface of the water in the tank. In the tank bottom an agitator keeps crushed rock in motion during the separating process.

Railway Improvements.

CATTLE-GUARD.—G. A. PRESTON, Monroe, La. This mechanism is designed to be placed between and on each side the tracks of a railway. It provides an efficient and a secure device to prevent cattle wandering on and across railway-tracks. It can be readily applied, removed or repaired, and will cause no injury to cattle if they come in contact with the guard.

CLIP FOR DETECTOR BARS.—G. SMITH, Jersey City, N. J. This design relates to a means for supporting detector-bars; and the object is to furnish a clip lying closely and compactly alongside the rail and adjustable to rails of various sizes. It also meets other conditions liable to arise in railway construction.

Vehicles and Their Accessories.

BICYCLE ATTACHMENT.—H. R. BLOOMBERG, Prentice, Wis. This attachment enables any bicycle of standard make to run upon one of the rails of a railroad-track. It consists of a braced frame adapted to be connected to the parts of the bicycle-frame and having guide-wheels that engage with both rails of the track to keep the bicycle-wheels in alinement with the rails and guide the machine to prevent it tipping or running off.

VEHICLE DRAFT ATTACHMENT.—A. P. SPEED, Louisville, Ky. The invention provides a draft attachment for team-drawn vehicles, which enables the team to exert a greater leverage for draft, both for starting the load and also in the normal travel of the vehicle. It is especially useful in climbing hills, or starting or in pulling out of holes.

Miscellaneous.

RACK FOR HOLDING FALSE TEETH.—O. E. WALL, Honolulu, Oahu, Hawaii. The aim of this invention is to supply a rack for holding false teeth which will serve also as an index to the dentist, to make selection in any work and to show him styles of teeth needed for completing his stock. The rack may be made in shapes and sizes required and compartments arranged for various sets of teeth.

NASAL DISH.—H. L. HARRIS, New York, N. Y. The nasal dish is especially designed to be used in applying a wash through the nose in such position that it will not pass down the throat. The dish may be made of glass, chinaware, sheet metal, gutta percha or other suitable material.

DEVICE FOR EXHIBITING WORKS OF ART.—W. WOOD, New York, N. Y. The general idea of the inventor is to produce a plurality of scenes from works of art, historic scenery, living pictures, etc., in such a relation as to be readily compared by spectators. His particular aim is to produce a device in which a central movable member is furnished with these scenes to be witnessed one at a time and closely following in a predetermined order.

NON-REFILLABLE BOTTLE. — C. F. HATELY, Rialto, Cal. The object obtained in this new improvement is the provision of simple novel details of construction for a bottle which will effectively prevent a reuse of the receptacle as a mercantile package, and thus prevent the fraudulent sale of a liquid counterfeiting that originally contained in the bottle.

TABLE ADJUSTABLE ANGULARLY AND VERTICALLY.—O. C. DORNEY, Allentown, Pa. Artists, architects, and the like, have obtained an improved table for their use by means of this invention. It is readily adjusted as to height and angle and is provided with supporting devices for lamps and tools or instruments, such as brushes, colors, inks, drawing implements, etc.

MANUFACTURE OF BRUSHES.—J. J. HAYDEN and J. P. POWERS, Ossining, N. Y. A marked advantage is gained in this improvement for street-brooms and scrubbing-brushes, for use on streets, floors, decks of vessels, etc. The brush is arranged to permit of reversing the back carrying the bristles or fibers, to allow uniform wear without splitting or warping the back.

COMBINED RULER AND BLOTTER.—H. C. PROBST, Chicago, Ill. This combination device has for its object the provision of a ruler which will be extremely flexible, so as to be easily used on either flat or rounding surfaces. The ruler is provided with a removable blotter on its lower surface and is proof against the collection of dust and grime particles.

PAPER-BAG HOLDER.—L. C. BUNNELL, Paris, Ky. Means are employed in this contrivance for holding paper bags in quantity lapped and clamped in sequence, ready for removal singly or in number. The holder is adapted for very efficient service and to enable the instant removal of one or more bags without disarranging others remaining in the holder.

ATTACHMENT FOR MEN'S OR BOYS' WAISTS.—H. SAUM, Brooklyn, N. Y. The attachment perfected here conveniently and quickly connects the waist with the trousers. It is readily detachable from the waist to permit washing of the waist, without hindrance by the device or danger of injuring the latter.

ENVELOP.—F. P. PIDGEON, Brooklyn, N. Y. Certain new and useful improvements are provided in this invention, whereby a number of envelops arranged in continuous length are detachably connected to allow of running the envelops through a type-writing machine for addressing them in a convenient and quick manner.

SELF-ACTING FAN FOR HAMMOCKS OR COTS.—G. D. MCELWEE, Gloster, Miss. This mechanism is actuated by the swinging motion of the hammock. Means are furnished for holding the fan out of the way of a person entering the cot and to assist in the actuation of the fan; also for the vertical adjustment of the fan, and to enable the fan mechanism to be applied or removed from the cot or hammock, and also to be fitted lengthwise of the cot to any position.

SCIENTIFIC TOY.—W. H. ZIMMERMAN, Halethorpe, Md. This apparatus consists of a mechanism, termed by the inventor "a blow mill," combined with accessory parts, which at the nominal price of a toy, takes the place of expensive laboratory apparatus, and is adapted to win the attention of old and young in demonstrating many important laws of nature in physics, mechanics, optics, composition of light, astronomy, etc.

COMPUTING-MEASURE.—F. C. REAM, Butler, Mo. The device is made in two telescopically-sliding sections which may be drawn out to a maximum capacity or forced together to reduce the volume to a fraction of the maximum. Even an uneducated person may readily and accurately measure any fractional part of a commodity at a fixed price without computing, the measure being itself a computer to settle any quantity at a definite price.

HEATING OR COOKING STOVE.—P. S. SPILLER, Austin, Texas. Mr. Spiller's invention relates to heating-stoves; and it consists of special details of construction and combination of parts adapted to any heating or cooking stove employing a grate should such stove have double walls suitable to form a heating-space similar to the space or passage encircling the body of the stove.

DRESS-SHIELD.—MARY G. TILNEY, Orange, N. J. The object attained in this improvement is the provision of simple means for securing a shield in place so that it may be readily removed and sewing obviated. The fastening devices consist of snap catches which may be readily snapped onto the seamlaps of the sleeve and waist.

SELF-CLOSING GATE.—J. W. HENDERSON, Tunica, Miss. This swinging gate is furnished with means whereby it will be automatically closed when opened. In operation the gate is pulled open to position for passage through. The weight being of sufficient heft, when the gate is freed by the person passing through, its strain on the cord will pull toward the fence the free end of an arm secured to the gate, and swing the gate to closed position. Here it is held until again forcibly opened.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 3957.—For dealers in scale parts.

Blowers and exhausters. Exeter Machine Works, Exeter, N. H.

Inquiry No. 3958.—For the manufacturers of the La Bastie gas lamp chimney.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3959.—For manufacturers of the largest locomotive, also addresses of makers of hay rakes and hay loaders.

Dies, stampings and armature discs. Advance Manufacturing Co., Racine, Wis.

Inquiry No. 3960.—For machinery for the manufacture of butter tubs, washtubs, pails, etc.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3961.—For machinery and apparatus for making cotton felt mattresses.

PATENT FOR SALE.—A. L. & O. Sovelius' Twine Holder. Price, $6,000. Hancock, Mich.

Inquiry No. 3962.—For makers of solar water heaters.

FOR SALE.—60 h. p. Otto gas engine, the latest type, practically new. Colborne Mfg. Co., Chicago.

Inquiry No. 3963.—For parties engaged in moulding cast iron into wrought iron.

Our specialty is cutting and forming metal parts any shape. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 3964.—For machinery for cutting down trees, cutting cord wood, piling, poles, etc.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3965.—For makers of machinery for making blankets and handles.

Machinery designed and constructed. Gear cutting, The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 3966.—For a small, portable gravity scale weighing from ½ ounce to 4 or 5 pounds.

Patent for Sale or on Royalty. No. 712,808. Attachment for cuspidor on railway coach. A. H. Kehr, Rupp's Building, York, Pa.

Inquiry No. 3967.—For information relative to installing a small plant for distilling oil from different herbs.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3968.—For dealers in brimstone, flour sulphur and crude creosote in large quantities.

AGENCY WANTED.—For a good selling article connected with the machinists supply business. William A. Tucker, 317 W. 45th Street, New York.

Inquiry No. 3969.—For dealers in compressed-air carpet cleaning apparatus.

Crude oil burners for heating and cooking. Simple, efficient and cheap. Fully guaranteed. C. F. Jenkins Co., 1103 Harvard Street, Washington, D. C.

Inquiry No. 3970.—For dealers in box makers' brass and tin specialties.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 3971.—For makers of paper bag and box-making machinery.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 3972.—For makers of folding box machinery, also supplies for paper box manufacturers.

Patent for Sale or on Royalty.—Internal cover for peas and beans, can boil soft without breaking; good for every family. M. Kratky, Utica, South Dakota.

Inquiry No. 3973.—For makers of calenders, also wholesale dealers in sheet celluloid.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3974.—For high temperature thermometers, up to 600° F.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $5. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 3975.—For makers of Baumé gravity testers from 40 to 80 for testing illuminating oils.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 775, New York.

Inquiry No. 3976.—For parties to manufacture a simple patented article on royalty.

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Inquiry No. 3977.—For parties to manufacture a measuring faucet.

Will estimate on General Machine Work or Mfr. Pat. Articles on Royalty. Address Greenfield Steam Engine Works, East Newark, N. J.

Inquiry No. 3978.—For machinery for making starch from potato or cassava.

Inquiry No. 3979.—For firms for making automatic bag-sewing machines.

Inquiry No. 3980.—For makers of automatic gas-lighting pellets.

Inquiry No. 3981.—For manufacturers of cotton and woolen machinery.

Inquiry No. 3982.—For makers of power machinery for making fish nets.

Inquiry No. 3983.—For makers of oil burners for heating steam or hot water furnaces.

Inquiry No. 3984.—For manufacturers of cold-drawn steel tubing, also makers of electrical welding steel tubing.

Inquiry No. 3985.—For makers of seamless aluminium tubing one inch in diameter.

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Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8903) C. A. B. asks for the chemical analysis of the so-called oil gas, that is, gas manufactured by the Patton or similar process. A. The composition of oil gas will greatly vary, dependent upon the oil used and the temperature of gasification. We give here the extremes selected from a table of analysis:

	Specific gravity 0.442	0.909
	Per Cent.	Per Cent.
Heavy hydrocarbon.	11.4	42.3
Methane	23.6	43.2
Hydrogen	20.7	57.3
Carbon monoxide	0.7	3.5
Carbon dioxide	0.2	1.7
Oxygen	0.3	0.6
Nitrogen	4.5	9.2
Sulphur compounds	none	0.24

The best book is Walter Hempel's "Methods of Gas Analysis," third edition, translated by L. M. Dennis. You will also find information as to the manufacture and uses of oil gas in our Supplements, Nos. 324, 783, 760, 886, 948, and 600; also Scientific American, No. 2, Vol. 79, and No. 7, Vol. 84. We will be pleased to forward these upon receipt of ten cents for each number desired.

(8904) F. G. B. asks what kind of driers can be used with tar paint to dry it in about two days and not affect glass and not crack. A. There are no substances that will act as driers with tar paint in the way that driers act with linseed oil. You will probably attain the desired result by dissolving a good quality of rather hard pitch in turpentine. Resin is sometimes also added, and it is claimed to give a better and more durable coat.

(8905) F. K. S. asks for a formula of an aquarium cement for putting in glass. A. Melt together at a gentle heat 3 parts of linseed oil, 4 parts of tar and 16 parts of resin. Use warm, not hot. Or take 8 ounces of a solution of glue and 1 ounce of Venice turpentine and boil together, stirring well until the mixture is complete. The joints to be cemented should be kept in close contact for a couple of days.

(8906) O. H. asks where the earth's center of gravity is. Supposing that a shaft goes through the earth's center, and a ball drops into it, where will the ball stop? A. The earth acts as if the center of gravity was at the center of the form of it. If a hole were made through the earth to the opposite side, and a ball were dropped into it, the ball would ultimately come to rest at the center of the earth.

(8907) W. R. M. asks how to unite broken pieces of gold, silver or bronze articles with what the jewelers call hard solder. I would like to know the details of the process, and also how to make the solder. Is there a solder for aluminium, and where can it be obtained? Can you recommend an inexpensive book on solders, brazing, welding, etc.? Can you give me the address of a retail dealer in small platinum tubing and wire? A. For formulæ for solders for various purposes, we refer to the "Scientific American Cyclopedia of Receipts," pages 52 and 525 to 530. For additional solders for aluminium, see answer to query No. 8751 in the Scientific American of November 22, 1902; also Supplements, Nos. 1040, 602, and 750. There is very little published in book form on soldering. We can supply you with H. Rowell's "Manual of Instruction in Hard Soldering" for 75 cents. For manufacturers of platinum ware, we refer you to Baker & Co., 120 Liberty Street, New York city, or to J. Bishop & Co., Sugartown, Pa.

(8908) J. R. C. asks what book he should buy to get the receipt for putting designs, etc., on glass, such as a photograph or a scene of any kind. I have seen it done by putting a liquid on a rubber stamp, then put your glass tumbler on the stamp and dust a white powder over it; then it was put in a baker and baked a certain length of time. I want to know what the liquid and powder are and how long to bake it? A. This method of etching glass is effected by the use of hydrofluoric acid, ammonium fluoride and acetic acid, or calcium fluoride and oil of vitriol. There are a considerable number of formulæ for this work, of which we give here a few. 1. Dissolve 8 parts of sodium fluoride in 100 parts of water, and add 1 part of oil of vitriol. 2. 10 parts sulphate of ammonia, 20 parts of oil of vitriol, 100 parts ammonium fluoride and 100 parts of water. 3. Stir 1 part of oil of vitriol into 4 parts of water and allow to cool; then stir in enough finely powdered fluorspar to the consistency of milk. Put this on the parts to be etched and dry at a temperature of 100 deg. to 120 deg. Repeat if necessary. Great care must be exercised in these processes of etching, as hydrofluoric acid will cause very painful burns if accidentally dropped on the skin, and the fumes of the acid are excessively irritating to the throat and lungs.

(8909) D. P. S. asks for some chemical for etching the name or initials on such tools as calipers, scales, and squares, as through stamping they are generally sprung out of shape? A. Cover the surface of the steel with a thin coat of asphalt varnish, then cut in the letters so as to expose the steel and etch with weak nitric acid. The asphalt can then be washed off with turpentine.

(8910) W. B. writes: Cayenne pepper put into rat-holes will at once clear premises of them. I have tried it in numbers of instances, and never knew it to fail. It is equally effective against skunks, weasels, etc.; even a coyote will give the place a wide berth.

(8911) C. E. H. asks: Kindly let me know what a slot magnet is, and also what is meant by compound winding. A. We are not able to tell you what a "slot magnet" is, since we have never seen the term before. The iron part of the armature of a dynamo is slotted to prevent heating by eddy currents, which would flow around it if it were not slotted. A compound-wound dynamo is one whose field has two windings; one of finer wire and high resistance, which is in shunt with the armature and the line, and one of coarse wire and fewer turns, which is in series with the armature and the line. The object is to furnish better regulation with varying load.

(8912) D. O. asks: What is Cornish stone, and what kind of soda, that is, crystal of soda, to use in the glazes in the "Cyclopedia of Receipts," as I am working on them; the wholesale drug houses here, they tell me there are many kinds of soda and potash. A. Cornish stone or Cornwall stone, so named because is comes from Cornwall, England, is a porous, weathered felspar, containing an admixture of more or less clay. It is worth in the powdered form about twenty dollars per ton, and can probably be purchased from dealers in powdered minerals. Crystal soda is simply the crystallized carbonate of soda, commonly called sal soda. It will be better to use the dry carbonate of soda, soda ash; in this case it should be remembered that four parts of soda ash are equivalent to ten parts of crystal soda.

(8913) W. A. P. asks: 1. The best way to reduce a 220-volt circuit down to 110 volts, 15 amperes, capacity. A. You wish 15 amperes to flow with a drop of 110 volts in a 220-volt circuit. Use a resistance of about 7.5 ohms of No. 10 wire, and this will produce a drop of 110 volts with a current of 15 amperes. The rest of the drop in series will be in your apparatus, which should have a resistance of 7.5 ohms, nearly. 2. How to electrically weld platinum wire No. 22 together, also platinum to copper; what, if any, flux is to be used? A. Electrical welding is done by melting the two parts to be united and forcing them together while melted. A flux is necessary to prevent oxidation. The same flux would be used as for the same metal in ordinary welding.

(8914) B. B. asks: 1. How to avoid scratches on the glass when cleaning with ashes before silvering? A. If you would avoid scratches on glass, you should avoid the use of ashes in polishing it. All wood ashes must contain particles of silica which are harder than the glass and will scratch the glass. Use successively finer abrasives till finally rouge and still finer polishes are used. 2. How to repolish plate glass when it loses its original polish? A. If glass has become dulled, it must be repolished by the same means as at first. 3. How to silver glass with tin instead of mercury amalgam process? A. Mirrors are made with tin and mercury amalgam by spreading sheets of tinfoil over a level stone slab, true and smooth, and pouring the desired amount of mercury over the tin. The sheet of glass is then lowered upon the amalgam from one edge, so as to drive the air bubbles out as it advances into contact with the amalgam. Weights are now put upon the glass, holding it down till the amalgam has set. The glass is now lifted from the stone. Any places where the coating is defective are repaired by coating them separately. 4. Is tin process of silvering, if any, cheaper than the ammoniated nitric of silver process? A. All mirrors are now coated with silver. It is a much better coating than mercury and tin.

(8915) W. G. asks: Could you suggest anything that I could mix with coal dust so it could be used for family use? A. Coal dust is briquetted by mixing with coal tar or pitch, subjecting to strong pressure, and usually partially coking after pressure. To be commercially successful it must be conducted on a very large scale as the installation is rather expensive. At the ordinary prices of anthracite, it has not hitherto proved economical to briquette coal fines in this country. Europe has no real anthracite, hence briquettes furnish the only form of smokeless fuel, besides coke.

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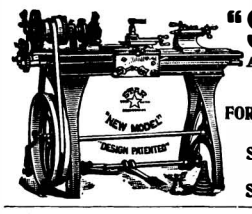

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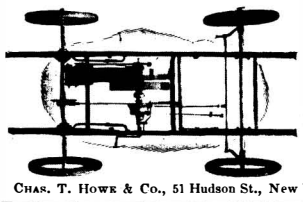

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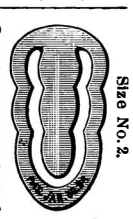

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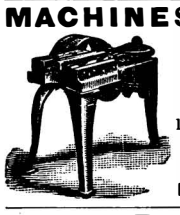

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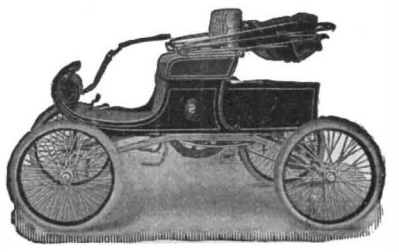

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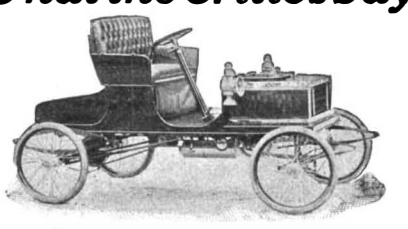

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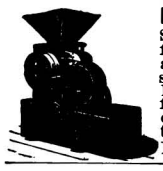

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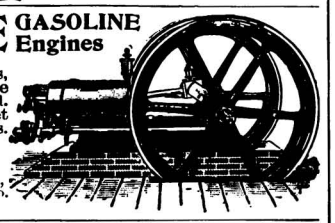

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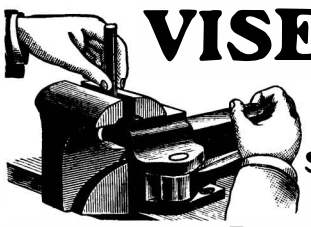

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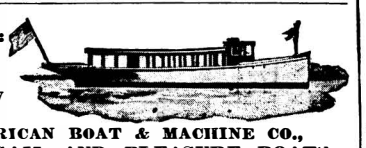

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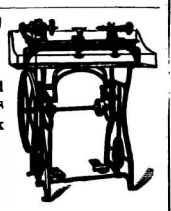

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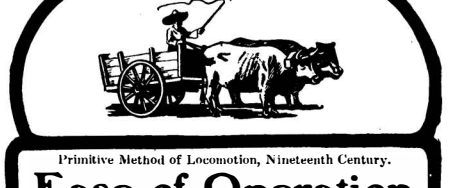

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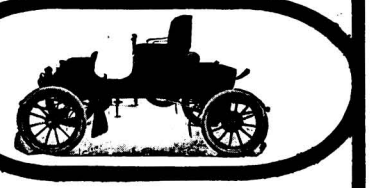

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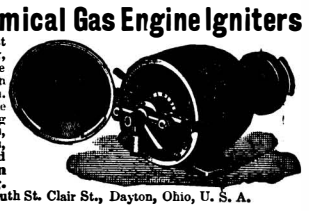

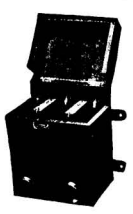

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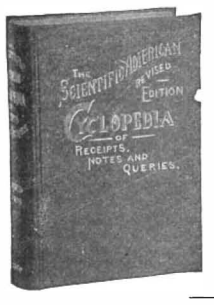

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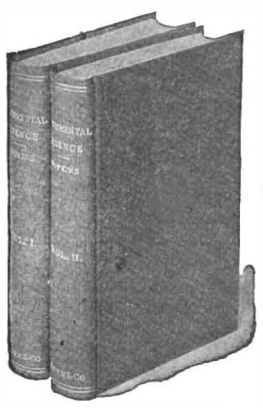

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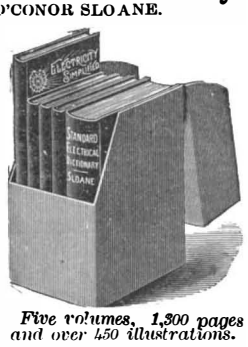

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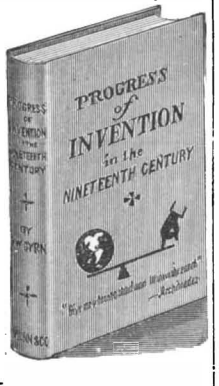

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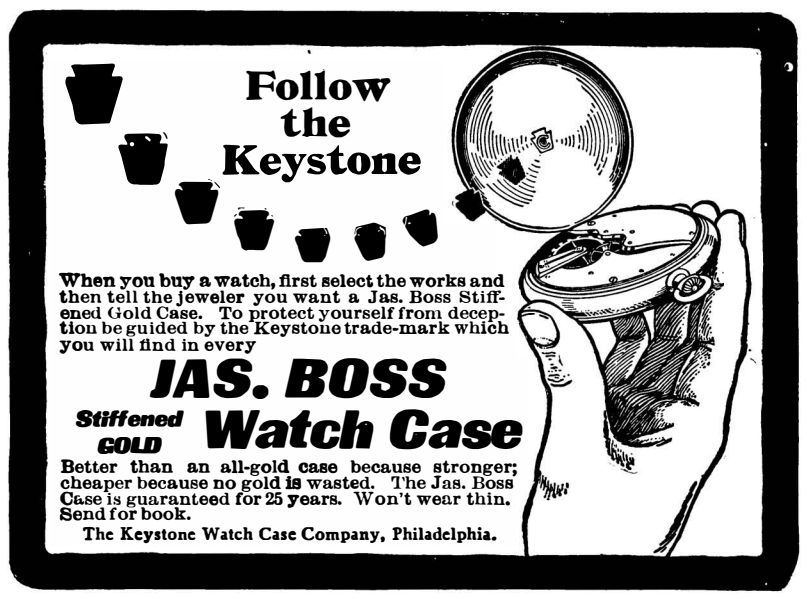

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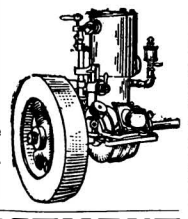

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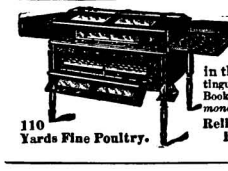

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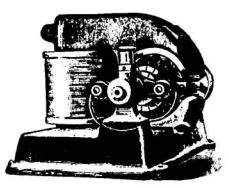

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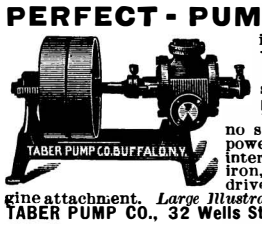

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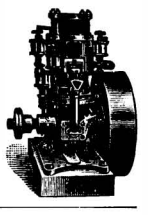

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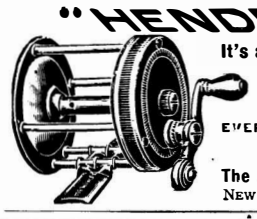

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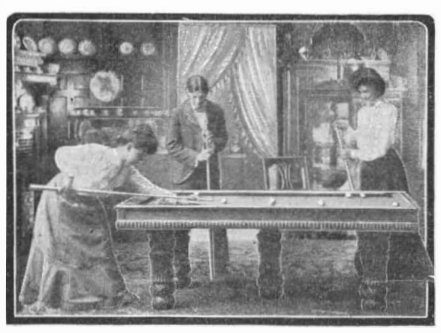

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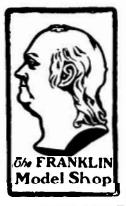

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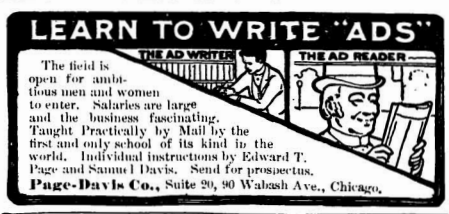

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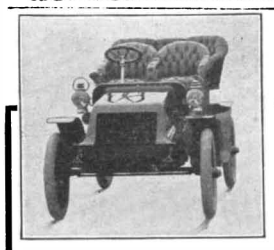

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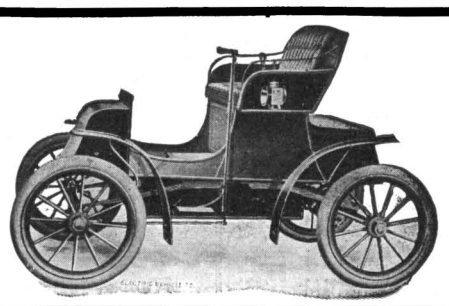

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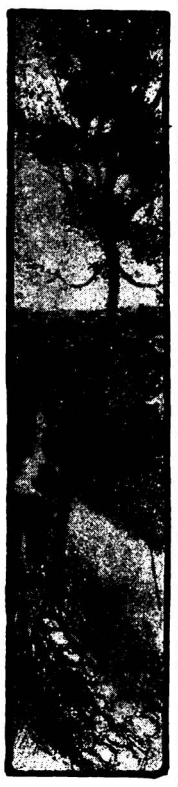

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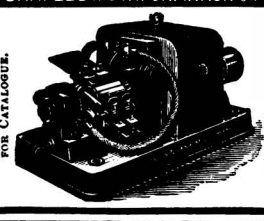

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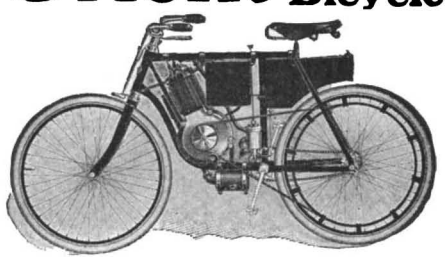

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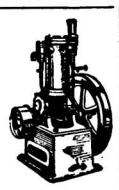

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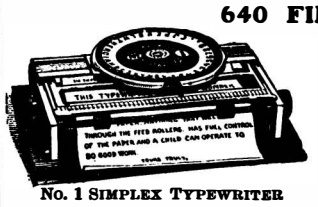

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